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1914/15

DEPARTMENT OF THE INTERIOR, CANADA

IRRIGATION BRANCH

E. F. DRAKE, Superintendent.

REPORT

ON

IRRIGATION SURVEYS AND INSPECTIONS

1915

Published by authority of Hon. W. J. Roche, Minister of the Interior

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OTTAWA
GOVERNMENT PRINTING BUREAU
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84696—1

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DEPARTMENT OF THE INTERIOR,
IRRIGATION BRANCH,
OTTAWA, July 31, 1915.

W. W. CORY, Esq., C.M.G.,
Deputy Minister of the Interior.

SIR,—I have the honour to submit herewith reports of some of the more important features of inspection and survey work carried on by the Irrigation Branch during the year 1914.

In order that the annual report of the department might be kept within reasonable limits of size, the report submitted by this branch was confined to a brief, general review of the work, although in previous years it had been customary to submit and publish full reports covering all branches of the work. Some features of the work, particularly those relating to surveys, are deemed to be of sufficient importance to justify their publication in a separate volume for distribution among those who may be interested in the subjects.

I have the honour to be, sir,
Your obedient servant,

E. F. DRAKE,
Superintendent of Irrigation.

DEPARTMENT OF THE INTERIOR,
IRRIGATION BRANCH,
CALGARY, June 24, 1915.

E. F. DRAKE, Esq.,
Superintendent of Irrigation,
Department of the Interior,
Ottawa.

SIR,—I have the honour to submit herewith reports on the more important branches of inspection and survey work carried on under my charge during the year 1914.

It has been customary in previous years to submit full reports from all the officers in charge of inspection and survey work and to have these, together with the general report of the commissioner, printed as part of the annual report of the department. The expansion of work due to the development of the western provinces has necessitated a change in this practice. A brief, general report on irrigation survey and inspection work has been submitted for publication in the annual departmental report, and there are submitted herewith reports from the officers in charge of the more important survey and inspection parties. I suggest that these reports are of sufficient importance to warrant their publication separately for the information of those who may be especially interested in any branch of the work.

I have the honour to be, sir,
Your obedient servant,

F. H. PETERS,
Commissioner of Irrigation and Chief Engineer.

NOTE.—The report of Mr. B. Russell, Chief Field Inspector, and the summary immediately following it prepared by the Commissioner of Irrigation, respecting estimates of irrigable area and costs, are based upon preliminary surveys and should not, therefore, be considered as in any way final. Further surveys are being carried out during the season of 1915 and until the information gained by this work can be tabulated and published in the next annual report the present estimates should be regarded in the nature of a progress report, the data contained therein being subject to modification as the results of more detailed work become available.

COST OF SMALL IRRIGATION SCHEMES.

The following three paragraphs are reprinted from the Irrigation Report of 1913. The table following contains the same twenty-one private schemes for which cost data were given in the earlier report, to which has been added cost data on forty-two additional private schemes. The water is diverted in all cases by gravity, unless otherwise noted.

The question is very often asked as a matter of interest: "What is the usual cost of the works in constructing small irrigation schemes?" To get the average cost, in this connection, of all the small irrigation schemes would entail a considerable amount of work, and lack of time has made it impossible to get all these details.

The following table, however, shows twenty-one schemes picked absolutely at random out of the office register, as applied for under the land sale regulations, approved by an Order in Council dated the 9th day of November, 1910, and amended by an Order in Council dated 25th of November, 1912.

The headings on this table make it quite easily understood, the idea having been to show the total amount expended by the applicant, the total area of land bought, and the irrigable area bought. The cost has been worked out per acre of the total area bought, but as a column has been inserted showing a percentage of irrigable area, this can easily be reduced to the cost per irrigable area.

File.	Name.	Tp. Rge. Mer.	Total cost of works.	Area bought.	Irrig. Area.	Per cent of Irrig. Area.	Cost per acre. Total Area.	—
			$ cts.	Acres.	Acres.	p. c.	$ cts.	
1136	D. Tenaile	8-22-3	375 00	160	100	63	2 35	
1162	W. Small	9-27-3	405 00	160	150	94	2 53	
1047	Muir & Frantzon	5- 2-4	1,147 00	480	260	54	2 36	
1229	J. A. English	7 -3-4	1,391 00	640	485	75	2 17	
1287	H. Parker	9-20-3	164 00	160	90	57	1 03	
1183	J. Garissere	6-23-3	442 00	160	80	50	2 76	
1297	W, B. Gregg	3-29-3	1,289 00	480	252·5	53	2 68	
1306	J. A. Burt	12- 2-5	205 00	160	120	75	1 28	
1369	McGarth & Morgan	8-27-3	128 00	160	90	57	0 80	
1411	K. Sinclair	10-19 3	465 00	160	86·5	54	2 90	
1404	H. E. & A. A. Dimmock	11-21-3	973 00	640	281·4	60	1 52	
1353	W. Moore	12-20-3	1,244 00	640	355	55	1 94	
1468	Park Hill & Forster	23-13-4	5,435 00	1,440	774·5	54	3 77	Pumping
1431	T. A. Drury	10-26-3	182 00	160	80	50	1 14	
1407	W. R. Holding	12-20-3	1,223 00	640	609	95	1 91	
1445	J. W. Lumley	1- 2-4	711 00	160	160	100	4 44	
1540	Gordon Ironside & Co.	14-30-4	175 00	160	80	50	1 09	
510	O. Baudry	17- 4-5	424 00	560	354	63	0 75	
1473	J. E. Jones	3-30-4	184 00	160	80	50	1 15	
1589	A. Peake	26-17-4	3,628 00	238	198	83	15 24	Pumping.
705	T. A. Drury	6-25-4	427 00	160	120	75	2 67	
1395	J. Read	6- 3-4	203 81	160	60	37 5	1 27	
1272	J. McGarry	9-27-3	241 51	160	61	38	1 51	
1489	J. M. Spangler	7-28 3	925 15	320	150	47	2 89	
1171	W. D. Reesor	8- 1-4	618 47	320	50	16	1 93	
1181	G. Udal	10-25-3	423 30	160	85	53	2 64	
1293	Clark & Thomson	7-21-3	687 62	320	80	25	2 14	
1341	T. B. Pearce	10-13-3	4,201 35	3,200	815	25	1 31	
1533	Berry Creek Ranch & Co.	23-12-4	21,674 84	4,480	2,451	55	4 83	
1015	J. Dixon	12-26-3	11,621 65	1,760	462	26	6 60	
1307	Wm. Putnam	10- 4-4	338 39	160	70	44	2 11	
675	A. H. & A. D. McKinnon	5-30-3	4,346 08	840	659	78	5 17	
1309	G. A. Legge	4 -2-4	1,056 60	320	140	44	3 30	
748	M. Lynch	2-29-3	4,176 28	640	254	39	6 52	
806	H. A. & A. R. Hansen	8- 1-4	322 54	320	67	21	1 01	

File.	Name.	Tp. Rge. Mer.	Total cost of works.	Area bought.	Irrig. Area.	Per cent of Irrig. Area.	Cost per acre. Total Area.
			$ cts.	Acres.	Acres.	p. c.	$ cts.
1191	D. A. Hammond	2-29-3	1,277 08	480	165	34	2 66
1514	Mrs. A. E. Foster	8- 8-4	1,582 53	320	255	79	4 94
1317	V. V. Rohg Co	22- 8-4	2,556 50	1,190	301	25	2 15
1073	D. Drinnan	13- 1-4	134 96	97	97	100	1 39
1475	A. G. Denbigh	7- 5-4	2,930 30	960	527	55	5 56
1290	M, M. M. & D. Spangler	2-29-3	6,576 74	1,600	1,227	76	4 11
1506	Miss A. H. Brown	8- 4-4	918 46	160	110	69	5 74
1326	J. E. Hartt	6- 3-4	518 74	320	80	25	1 65
926	Hooper & Huckvale	5- 7-4	4,463 27	2,240	1,500	67	1 99
564	J. A. Gaff	5-23-3	4,997 65	1,120	614	54	4 46
824	W. X. Wright	5-30-3	1,436 56	480	349	72	2 99
1346	Wright & Alexander	5-30-3	2,660 63	640	365	57	4 15
1274	D. White	9-27-3	292 39	320	110	34	0 91
1591	J. H. Williams	12-26-3	4,649 76	960	557	58	4 84
849	W. S. Wilson	6-28-3	3,591 35	480	183	38	7 48
1269	Kearney Bros	8-24-3	4,537 82	1,120	300	26	4 05
1214	S. W. Hewitt	7-26-3	283 70	160	90	56	1 77
1390	G. Pollock	9-27-3	614 46	480	274	57	1 28
1193	B. C. Wright	8-25-3	229 82	640	158	25	0 36
1192	R. P. & W. F. Gilchrist	4-27-3	682 87	160	75	47	4 26
1119	F. W. Henry	5-28-3	1,462 40	640	259	40	2 28
1158	Armstrong Bros	7-24-3	2,090 27	1,440	645	45	1 45
1028	A. S. Duncan	6-20-3	1,445 61	640	320	50	2 25
941	G. W. Morrison	6-20-3	4,002 19	640	490	76	6 25
878	Watson Bros	5-20-3	2,882 36	1,280	545	43	2 25
1405	Dimmock Bros	11-21-3	973 38	640	381	59	1 52
668	Morrison Bros	6-20-8	5,655 96	1,760	1,105	62	3 21
1027	N. C. Nelson	5-24-3	2,678 55	960	286	29	2 79
	Average					50	3 21

IRRIGATION SURVEY BENCH-MARKS REDUCED TO MEAN SEA-LEVEL DATA.

Commencing with the field season of 1911 a large number of permanent iron bench-marks have been set over a wide area of country, and the bench-marks which have been set in previous years have been listed and published in previous reports. The data of the several groups of bench-marks all differ considerably, having been derived mainly from Canadian Pacific Railway track elevations.

The following schedule shows all the bench-marks which have been set since 1911 by the irrigation survey parties, and the elevations have all been reduced to mean sea-level data, which have become available through the courtesy of the officials of the Geodetic Survey of Canada. The schedule has been arranged to show the bench-marks located by meridian, range, and township for ease of reference.

The number of bench-marks set during 1911, 1912, and 1913 have all been published separately, and for the purpose of record all the bench-marks set during 1914 have been marked in the accompanying schedule with a "†." There are a number of hydrometric survey bench-marks which have been set but for which no mean sea-level datum is obtainable, and it is to be noted that these bench-marks are not included in the following schedule.

BENCH-MARKS IN ALBERTA AND SASKATCHEWAN.

Mean Sea-level Datum as established by the Geodetic Surveys of Canada.

Number.	Location.				Elevation Original Datum.	Equation.	Elevation Geodetic Datum.	Remarks.
	Township.	Range.	Meridian.	Remarks.				
					Feet.	Feet.	Feet.	
....	10	19	W. 2nd..	NE. cor., Sec. 36 .	1904·57	6·281	1910·85	On Sec. post.
400	11	19	" ..	N.¼ " 34..	1879·24	6·281	1885·52	Permanent Govt. B.M.
401	17	20	" ..	NE. " 31..	1876·49	6·28	1852·77	" "
402	16	20	" ..	NE. " 36..	1881·99	6·281	1887·27	" "
....	17	23	" ..	NE. " 35..	1888 23	6·28	1894·51	" "
403	13	24	" ..	NE. " 24..	1919·78	6·281	1926·06	" "
404	17	24	" ..	NE. " 31..	1895·65	6·28	1901·93	" "
405	18	25	" ..	E. ¼ mound, Sec. 7	1924·29	6·28	1930·57	" "
406	18	25	" ..	NE. cor., Sec. 34 .	1679·22	6·28	1685·50	" "
407	16	27	" ..	E. ¼ " 1.	1939·02	6.281	1945·30	" "
408	17	27	" ..	NE. " 36..	1921·95	6·28	1928·23	" "
409	18	27	" ..	NE. " 20..	1941·15	6·28	1947·43	" "
410	18	27	" ..	NE. " 24..	1940·52	6·28	1946·80	" "
411	18	28	" ..	E. ¼ mound, Sec. 20	1954·29	6·28	1960·57	" "
412	21	29	" ..	NE. cor., Sec. 24..	1728·69	6·28	1734·97	" "
.....	.....	.....	.....	West end N. wall, C.P.R. station at Regina.....	1890·91	6·281	1897·191	Geodetic B.M. (tie made here).
413	17	1	W. 3rd...	N. Bdy., C.P.R. R. of Way, near N.E. cor. Sec. 23.....	1954·27	6·28	1960·55	Permanent Govt B.M.
414	19	1	" ..	NE. cor., Sec. 1..	1954·49	6·28	1960·77	" "
415	18	2	" ..	NE. " 21..	1966·30	6·281	1972·58	" "
416	19	2	" ..	NE. " 36..	1959·34	6 281	1965·62	" "
417	23	2	" ..	NE. " 16..	1806·70	6·28	1812·98	" "
418	19	3	" ..	E. ¼ " 4..	1973·60	6·28	1979·88	" "
419	19	3	" ..	NE. " 25..	1986·07	6·28	1992·35	" "
420	20	3	" ..	NE. " 24..	1959·19	6·281	1965·47	" "
421	22	3	" ..	NW. cor. Townsite Tugaski, Sec. 13.	1968·62	6·281	1974·90	" "
422	19	4	" ..	E. ¼ cor., Sec. 24..	1985·59	6·28	1991·87	" "
423	23	4	" ..	E. ¼ " 25..	1740·99	6·28	1747·27	" "
424	19	5	" ..	NE. " 26..	1980·73	6 28	1987·01	" "
425	19	5	" .	E. ¼ " 36..	1961·14	6·28	1967 42	" "
426	20	6	" ..	NE. " 35.	1983·82	6·28	1990·10	" "
427	24	6	" ..	NE. " 13..	1733·99	6 28	1740·27	" "
428	21	7	" ..	NE. " 14..	2011·74	6·28	2018·02	" "
429	21	7	" ..	NE. " 6..	2083·08	6·28	2089·36	" "
....	11	22	" .	NE. cor.	2513·555	34·54	2548·035	I. P. Temporary Govt. B. M.
430	6	25	" ..	SW. ¼ Sec. 30.....	3168·57	34·54	3203·11	Permanent Govt. B. M. (Hydrometric).
431	6	25	" ..	N.E.¼ Sec. 29....	3183 06	34·54	3217·60	Permanent Govt. B. M. (Hydrometric.
432	6	26	" ..	NE.¼ " 20	3184·37	34·54	3218·91	" "
433	6	26	" ..	NW.¼ " 24	3196·25	34·54	3230·79	Permanent Govt. B.M.
434	11	26	" ..	S. Bank of Maple Creek at E. bdy. Sec. 16.....	2465 335	34·54	2499·875	" "
	11	26	" ..	N. W. Corner Dixon Bros. Store Maple Creek in Sec. 15.....	2472·80	34·54	2507·34	Old B.M. No. 118. Established in 1896.
435	6	27	" ..	SE.¼ Sec. 12.....	3199·63	34·54	3234·17	Permanent Govt. B. M. (Hydrometric.
436	6	27	" ..	NE.¼ " 16.....	3165·09	34·54	3199·63	" "
437	6	27	" ..	NW.¼ " 20.....	3203·75	34·54	3238·29	" "

BENCH-MARKS IN ALBERTA AND SASKATCHEWAN—*Continued.*

Mean Sea-level Datum as established by the Geodetic Surveys of Canada.

Number.	Location.				Elevation Original Datum.	Equation.	Elevation Geodetic Datum.	Remarks.
	Township.	Range.	Meridian.	Remarks.				
					Feet.	Feet.	Feet.	
	10	27	W. 3rd...	NE. Cor.	2576·981	34·54	2611·521	Temporary Govt. B.M. 6′0″ N.W. of Mound.
	11	27	" ..	SE. "	2500·197	34·54	2534·737	Temporary Govt. B.M.
	6	28	" ..	SW.¼ Sec. 2.....	3187·94	34·54	3222·48	Temporary Govt. B.M. Spike in post.
	10	28	" ..	NE. Cor.....	2677·794	34·54	2712·334	Top of Township Post.
	11	28	" ..	SE. "	2718·513	34·54	2753·053	I. P. Temporary Govt. B.M. in W. Pit in Mound.
	11	28	" ..	NE. "	2520·815	34·54	2555·355	I. P. Temporary Govt. B.M.
	1	29	" ..	SE.¼ Sec. 12.....	2718·83	34·54	2753·37	Temporary Govt. B.M. (Hydrometric).
	1	29	" ..	" 12. ..	2752·33	34·54	2886·87	
438	3	29	" ..	NE. Cor.....	3136·03	34·54	3170·57	Permanent Govt. B.M.
439	3	29	" ..	SE. "	2967·88	34·54	3002·42	" "
440	4	29	" ..	NE. "	3249.49	34·54	3284·03	" "
441	5	29	" ..	NE. "	3415·12	34·54	3449·66	" "
442	5	29	" ..	SW.¼ Sec. 30.. ...	3297·37	34·54	3331·91	Permanent Govt. B.M. (Hydrometric).
443	5	29	" ..	NE.¼, Sec. 33.....	3313·27	34·54	3347·81	" "
444	5	29	" ..	NE.¼, " 34.....	3209·16	34·54	3243·70	" "
445	5	29	" ..	NE. Cor.	3415·12	34·54	3449·66	" "
	6	29	" ..	NE. Cor. Sec. 33..	3663·539	34·54	3698·079	Temporary Govt. B.M.
446	7	29	" ..	NE. " " 34.	4376·666	34·54	4411·206	Permanent Govt. B.M.
	10	29	" ..	NE. "	2832·612	34·54	2867·152	I. P. Temporary Govt. B. M. in W. Pit of Mound
	11	29	" ..	SE. "	2920·327	34·54	2954·867	" "
	11	29	" ..	NE. "	2623·173	34·54	2657·713	" "
447	2	30	" ..	SE. "	2926·05	34·54	2960·59	Permanent Govt. B.M.
448	3	30	" ..	NE. "	3235·78	34·54	3270·32	" "
449	4	30	" ..	NE. "	3270·11	34·54	3304·65	" "
450	5	30	" ..	NE. "	3472 36	34·54	3506·90	" "
	5	30	" ..	NE. "	3472·356	34 54	3506·896	Top of Township post.
	10	30	" ..	NE. "	2744·677	34·54	2779·217	" "
	11	30	" ..	NE. "	2393·290	34·54	2427·830	Temporary Govt. B.M.
451	2	1	W. 4th...	NE. Cor.....	2977·91	34·54	3012·45	Permanent Govt., B.M.
452	3	1	" .	SW. Cor.....	3006·03	34·54	3040·57	" "
453	3	1	" ..	NW. ¼ Sec. 36....	3008 38	34·54	3042·92	" "
454	3	1	" ..	NE. Cor.	3038·37	34 54	3073·11	" "
455	4	1	" ..	"	3311·65	34·54	3346·19	" "
456	5	1	" ..	NE. Cor. Sec. 24..	3445·481	34·54	3480·021	" " (Hydrometric)
457	5	1	" ..	NE. Cor.....	3580·588	34·54	3615·128	Permanent Govt., B.M.
458	8	1	" ..	NE. Cor. Sec. 24...	4430·789	34·54	4471·329	" "
....	8	1	" .	" " ..	3774·666	34·54	3809·206	Top of Township Posts.
...	9	1	" ..	" " ..	3084·014	34·54	3118·554	" "
459	11	1	" ..	" " ..	2410 072	34·54	2444·612	Permanent Govt., B.M.

BENCH-MARKS IN ALBERTA AND SASKATCHEWAN—*Continued.*

Mean Sea-level Datum as established by the Geodetic Surveys of Canada.

Number.	Location.				Elevation Original Datum.	Equation.	Elevation Geodetic Datum.	Remarks.
	Township.	Range.	Meridian.	Remarks.				
					Feet.	Feet.	Feet.	
.....	11	1	W. 4th...	South Bank Mackay Ck., Nr. Traffic Bridge in Sec. 26.....	.....	.....	2443·73	Permanent Govt., B.M. (Hydrometric).
460	3	2	" ..	NE. Cor.....	3203·97	34 54	3238·51	Permanent Govt., B.M.
461	3	2	" .	SW. Cor	2955·47	34·54	2990·01	" "
462	4	2	" ..	NE. Cor	3339·98	34·54	3374·52	" "
463	4	2	" .	"	3581·07	34·54	3615·61	" "
.....	11	2	" ..	South Bank Ross Ck. Nr. Traffic Bridge in Sec. 31.	.....	.....	.....	(Hydrometric).
464	3	3	" ..	NE. Cor.....	3164·23	34·54	3198·77	Permanent Govt. B. M.
465	4	3	" ..	"	2538·09	34·54	3572·63	" "
466	5	3	" ..	"	3524·68	34·54	3559·22	" "
.....	12	5	" ..	West Bank of Bullshead Ck., near Traffic Bridge in Sec. 16.	....	.....	2305·53	Permanent Govt., B.M. (Hydrometic).
467	3	7	" ..	NE. Cor.....	2801·53	31·96	2833·49 +	" "
..	3	7	" ..	SE. "	3210·03	31·96	3241 99 +	Top of Iron Pin.
468	4	7	" ..	NE. "	2814·09	31·96	2846·05 +	Permanent Govt. B. M.
469	3	8	" ..	SE. "	2944·20	31 96	2976·16 +	" "
470	5	8	" ..	NE. "	2824 73	31·96	2856·09 +	" "
471	6	8	" ..	" "	2702·89	31·96	2734 85 +	" "
472	3	9	" ..	SE. "	2844·11	31·96	2876·07 +	" "
473	3	9	"	NE. "	2937·92	31·96	2969·88 +	" "
474	4	9	" .	" "	2848·75	31·96	2880·71 +	" "
475	5	9	" .	" "	2827·31	31·96	2859·27 +	" "
476	6	9	" ..	" "	2772·23	31·96	2804·19 +	" "
477	3	10	" ..	" "	3032·59	31·96	3064·55 +	" "
478	3	10	" .	SE. "	2941·68	31·96	2973·64 +	" "
479	4	10	" ..	NE. "	2976·75	31·96	3008·71 +	" "
480	5	10	" ..	" "	2864·65	31·96	2896·61 +	" "
481	6	10	" ..	" "	2756·95	31·96	2788·91 +	" "
482	3	11	"	" "	3049·14	31·96	3081·10 +	" "
.....	3	11	" ..	SE. "	2949·00	31·96	2980·96 +	Top of Iron Pin.
483	4	11	" .	NE. cor.....	3005·00	31 96	3036·96 +	Permanent Govt. B.M.
484	5	11	" ..	NE. "	2977·09	31·96	3009·05 +	" "
485	6	11	" ..	NE. "	2821·71	31·96	2853·67 +	" "
486	7	11	" .	NE. "	2658·48	31·96	2690·44 +	" "
487	8	11	" .	NE.	2714·82	31·96	2746·78 +	" "
488	9	11	" ..	NE. "	2711·28	31·96	2743·24 +	" "
.....	3	12	" .	SE. "	3160·62	31·96	3192·58 +	Top of Iron Pin.
.....	3	12	" .	NE. "	3162·73	31·96	3194·69 +	" "
489	4	12	" ..	NE. "	3050·02	31·96	3081·98 +	Permanent Govt. B.M.
490	5	12	" ..	NE. "	2915·90	31·96	2947·86 +	" "
491	6	12	" ..	NE. "	2839·95	31·96	2871·91 +	" "
492	7	12	" ..	NE. "	2734·12	31·96	2766·08 +	" "
493	8	12	" .	NE. "	2656·47	31·96	2688·43 +	" "
494	9	12	" ..	NE. "	2599·48	31·96	2631·44 +	" "
495	10	12	" ..	NE. "	2518·10	31·96	2550·06 +	" "
.....	3	13	" ..	SE. "	3010·59	31·96	3042·55 +	" "
....	3	13	" ..	NE. "	3062·58	31·96	3094·54 +	" "
.....	4	13	" ..	NE. "	3033·42	31·96	3065·38 +	" "
.....	5	13	" ..	NE. "	3021·93	31·96	3053·89 +	" "
496	6	13	" ..	NE. "	2627·03	31·96	2658·99 +	" "
497	7	13	" .	NE.....	2749·23	31·96	2781·19 +	" "

BENCH-MARKS IN ALBERTA AND SASKATCHEWAN—*Continued.*

Mean Sea-level Datum as established by the Geodetic Surveys of Canada.

Number.	Location.				Elevation Original Datum.	Equation.	Elevation Geodetic Datum.	Remarks.
	Township.	Range.	Meridian.	Remarks.				
					Feet.	Feet.	Feet.	
498	8	13	W. 4th..	NE. cor..	2681·34	31·96	2713·30 +	Permanent Govt. B.M.
499	9	13	" ..	NE. "	2652·27	31·96	2684·23 +	" "
500	10	13	" ..	NE. "	2617·62	31·96	2649·58 +	" "
501	3	14	" ..	NE. "	3005·70	31·96	3037·66 +	" "
.....	3	14	" .	SE. "	3070·84	31·96	3102·80 +	Top of Iron Pin.
502	4	14	" ..	NE. "	2984·62	31·96	3016 58 +	Permanent Govt. B.M.
503	5	14	" ..	NE. "	3008·73	31 96	3040·69 +	" "
504	6	14	" ..	NE.....	2889·11	31·96	2921·07 +	" "
505	7	14	" ..	NE....	2829·96	31·96	2861·92 +	" "
506	8	14	" ..	NE. cor.....	2736·15	31·96	2768·11 +	" "
507	9	14	" ..	NE. "	2614·81	31·96	2646·77 +	" "
508	10	14	" ..	NE. "	2506·59	31·96	2538 55 +	" "
509	3	15	" ..	SE. "	3040·54	31 96	3072·50 +	" "
510	3	15	" ..	NE. "	3037·38	31·96	3069·34 +	" "
511	4	15	" ..	NE. "	3053·75	31·96	3085·71 +	" "
512	5	15	" ..	NE "	3025·86	31·96	3057·82 +	" "
513	6	15	" ..	NE.....	2973·19	31 96	3005·15 +	" "
514	7	15	" ..	NE. cor.....	2881·65	31·96	2913·61 +	" "
515	8	15	" ..	NE. cor.....	2831·58	31·96	2863·54 +	Permanent Govt. B.M.
516	9	15	" ..	NE. "	2681·72	31·96	2713·68 +	" "
517	10	15	" ..	NE. "	2547·96	31·96	2579·92 +	" "
.....	2	16	" ..	N. bank Milk river near railway bridge in sec. 21.	....	.....	3412·42 +	" " (Hydrometric).
518	3	16	" ..	NE. cor.....	3191·24	31·96	3223·20 +	Permanent Govt. B.M.
519	3	16	" ..	SE. "	3415·37	31·96	3447·33 +	" "
520	4	16	" ..	NE. "	3093·43	31·96	3125·39 +	" "
521	5	16	" ..	NE. "	2888·67	31·96	2920·63 +	" "
522	6	16	" ..	NE. "	3052·71	31·96	3084·67 +	" "
523	7	16	" ..	NE.cor.....	2915·10	31 96	2947·06 +	" "
.....	8	16	" ..	NE. "	2686·55	31·96	2718·51 +	Top of Iron Pin.
524	9	16	" ..	NE. "	2625·11	31·96	2657·07 +	Permanent Govt. B.M.
525	10	16	" ..	NE. "	2528·24	31·96	2560·20 +	" "
526	11	16	" ..	NE. " sec. 34..	2405·32	31·96	2437·28 +	" "
527	3	17	" ..	NE. "	3324·90	31·96	3356·86 +	" "
528	3	17	" ..	NE. " sec. 1.....	3447·94	31·96	3479·90 +	" "
529	4	17	" ..	NE. "	3215·00	31·96	3246·96 +	" "
530	5	17	" ..	NE. "	3087·46	31·96	3119·42 +	" "
531	6	17	" ..	NE. "	3084·02	31·96	3115·98 +	" "
532	7	17	" ..	NE.cor.....	2961·85	31·96	2993·81 +	" "
533	8	17	" ..	NE. "	2745·60	31·96	2777·56 +	" "
534	8	17	" ..	NE. "	2745·615	31·96	2777·57 +	" "
535	9	17	" ..	NE. "	2635·82	31·96	2667 78 +	" "
536	10	17	" ..	NE. "	2429·63	31·96	2461·59 +	" "
537	10	17	" ..	SE. "	2585·27	11·02	2596·29 +	" "
538	11	17	" ..	NE. "	2582·31	11·02	2593·33 +	" "
539	12	17	" ..	NE. "	2596 03	11·02	2607·05 +	" "
540	13	17	" ..	NE. "	2603·10	11·02	2614·12 +	" "
541	3	18	" ..	NE. "	3444·44	31·96	3476·40 +	I. P. Temporary Govt. B.M.
542	4	18	" ..	NE. "	3176·03	31·96	3207·99 +	Permanent Govt. B.M.
.....	5	18	" ..	NE. "	3128·23	31·96	3160·19 +	" "
543	8	18	" ..	NE. "	2879·72	31·96	2911·68 +	" "
544	9	18	" ..	NE. "	2667·92	31·96	2699·88 +	" "
545	10	18	" ..	NE. "	2683·34	11·02	2694·36 +	" "
546	11	18	" ..	NE. "	2929 64	11·02	2940·66 +	" "
547	12	18	" ..	NE. "	2673·42	11·02	2684·44 +	" "
548	13	18	" ..	NE. "	2570·74	11·02	2581·76 +	" "

BENCH-MARKS IN ALBERTA AND SASKATCHEWAN—*Continued.*

Mean Sea-level Datum as established by the Geodetic Surveys of Canada.

Number.	Location.				Elevation Original Datum.	Equation.	Elevation Geodetic Datum.	Remarks.
	Township.	Range.	Meridian.	Remarks.				
					Feet.	Feet.	Feet.	
549	14	18	W. 4th...	NE. cor.....	2611·91	11·02	2622·93 +	Permanent Govt.
550	15	18	" ...	NE. "	2576·29	11·02	2587·31 +	B.M.
551	5	19	" ...	NE. " sec. 30.....	3207·49	31·96	3239·45 +	" "
								" "
552	7	19	" ...	NE. "	3035·21	31·96	3067·17 +	" "
553	8	19	" ...	NE. "	2859 91	31·96	2891·87 +	" "
554	11	19	" ...	NE. "	2738·88	11·02	2749·90 +	" "
555	12	19	" ...	NE. "	2682·90	11·02	2693·92 +	" "
556	13	19	" ...	NE. "	2654·47	11·02	2665·49 +	" "
557	14	19	" ...	NE. "	2604 04	11·02	2615·06 +	" "
558	15	19	" ...	NE. "	2658·96	11 02	2669·98 +	" "
559	16	19	" ...	NE. "	2669 39	11·02	2680·41 +	" "
560	5	20	" ...	NE. ¼ sec. 30.....	3196·63	31·96	3228·59 +	" "
561	5	20	" ...	NE. cor. 11.....	3305·77	31·96	3337·73 +	" "
562	11	20	" ...	NE. "	2784·15	11·02	2795·17 +	" "
563	10	20	" ...	NE. " sec. 35.....	2779·88	11·02	2790·90	" "
564	12	20	" ...	NE. "	2769·48	11·02	2780·50 +	" "
565	13	20	" ...	NE. "	2707·74	11·02	2718·76 +	" "
566	14	20	" ...	NE. "	2686·86	11·02	2697·88 +	" "
567	15	20	" ...	NE. "	2788·11	11·02	2799·13 +	" "
568	16	20	" ...	NE. "	2790·75	11·02	2801·77 +	" "
569	10	21	" ...	NE. " sec. 35.....	2907·01	11·02	2918·03	" "
570	11	21	" ...	NE. "	2869·60	11.02	2880·62	" "
571	4	21	" ...	NE. " sec. 33.....	3652·33	31·96	3684·29 +	" "
572	3	22	" ...	NE. " " 36...	3701·78	31·96	3733·74 +	" "
573	5	22	" ...	NE. " " 12.....	3393·66	31·96	3425·62 +	" "
574	10	22	" ...	NE. " " 35.....	3012·61	11·02	3023·63	" "
575	1	23	" ...	NE. ¼ sec. 11.....	4098.20	31·96	4130·16 +	Permanent Govt. B. M. (Hydrometric)
576	2	23	" ...	NE. cor. sec. 7.....	4098·69	31·96	4130 65 +	Permanent Govt. B.M.
577	3	23	" ...	NE. " " 36...	3816·94	31·96	3848·90 +	" "
578	3	23	" ...	NE. " " 17...	3975·09	31·96	4007.05 +	" "
579	9	23	" ...	NE. "	3055·16	11·02	3066·18	" "
580	10	23	" ...	NE. " sec. 35.....	3203·92	11·02	3214·94	" "
581	11	23	" ...	NE. "	3131·01	11·02	3142·03	" "
582	12	23	" ...	NE. "	3261 45	11·02	3272·47	" "
583	1	24	" ...	SW. " sec. 3.....	4216·42	31·96	4248·38 +	" "
584	2	24	" ...	NE "	3926·88	31·96	3958·84 +	" "
	8	24	" ...	NE. " Old Lethbridge Court House, in Sec. 31.....	2958·78	34·65	2993·43	Old B.M. No. 75, Established in 1894.
585	10	24	" ...	NE. cor. sec. 35.....	3239·36	11·02	3240·38	Permanent Govt. B.M.
586	11	24	" ...	NE. "	3134·22	11.02	3145.24	" "
587	12	24	" ...	NE. "	3121·78	11·02	3132·80	" "
588	1	25	" ...	N.E. cor., Sec. 1. .	4195·11	31·96	4227·07 +	" "
589	1	25	" ...	S¼ mound, Sec. 5..	4139·48	31·96	4171·44 +	" "
	1	25	" ..	N.E. cor., Sec. 36..	3937·84	34·17	3972·01	Old B.M. No. 90 Estd. in 1895.
	1	25	" ..	N.E. " " 9..	4018·82	34·17	4052·99	Top of Iron Post.
590	1	25	" ...	E. ¼ " " 8..	4054·28	34·17	4088·95	Permanent Govt. B.M.
591	10	25	" ...	N.E. cor., Sec. 35	3142 95	11·02	3153·97	" "
592	11	25	" ...	N.E. cor.....	3169·19	11·02	3180·21	" "
593	12	25	" ...	"	3179·84	11·02	3190·86	" "
594	1	26	" ...	275' E. of N.E. cor., Sec. 10	4332·66	34·17	4366·83	" "
595	2	26	" ...	E. ¼ cor., Sec. 6....	4394 36	34·17	4428·53	" "
596	10	26	" ...	N.E. cor., Sec. 35..	3214·80	11·02	3225·82	" "

BENCH-MARKS IN ALBERTA AND SASKATCHEWAN—*Continued.*

Mean Sea-level Datum as established by the Geodetic Surveys of Canada.

Number.	Location.				Elevation Original Datum.	Equation.	Elevation Geodetic Datum.	Remarks.
	Township.	Range	Meridian.	Remarks.				
						Feet.		
597	11	26	W. 4th..	N.E. cor.....	3229·67	11·02	3240·69	Permanent Govt. B.M.
598	12	26	" ..	"	3220 66	11·02	3231·68	" "
599	13	26	" ...	"	3182 60	11·02	3193 62	" "
600	2	27	" ...	N.E. cor., Sec. 5..	4372·65	34·17	4406·82	" "
601	9	27	" ...	" " 10...	3207 75	11·02	3218·77 +	" "
602	10	27	" ...	On Willow creek, 2418′ N. 61° 57′ from N.E. cor....	3249·36	11·02	3260·38	" "
603	2	28	" ...	1912′ S. of E. ¼ cor. Sec. 12	4396·87	34·17	4431·04	" "
604	2	28	" ...	At Cable Station, Belly river, West's Ranch, N. E. Sec. 5.....	4356·74	34·17	4390·91	" "
605	2	29	" ..	At Waterton river Cable Station, N. E. Sec. 8.....	4162 56	34·17	4196·73	" "
606	.....	.....	.....	On Oldman river, 1500′ below mouth of Beaver creek..	3284 56	11·02	3295·58	" "
607	.....	.....	.....	Oldman river, 1 mile below Indian Mission.....	3300·55	11·02	3311·57	" "
608	.....	.....	.....	Sill of Headgate, A. R. & I. Co's., Canal at Kimball, Alta	3853 80	34·17	3887·98	" "

NOTE.—All Bench-Marks shown with a number from 400 up are the type of Permanent Iron Bench-Marks adopted by the Irrigation Branch, Department of the Interior, 1911. The remainder are permanent Bench-Marks of a different type.

EASTERN MAPLE CREEK IRRIGATION DISTRICT.

REPORT OF M. H. FRENCH, INSPECTING ENGINEER.

CALGARY, ALTA., February 8, 1915.

I have the honour to submit herewith a report of services performed by my party in the eastern Maple Creek irrigation district for the year 1914.

DURATION OF WORK.

The party, which consisted of a chief and assistant, draughtsman, rodman, teamster and cook, was assembled the first week in May in a camp at Maple Creek. From that point several camps were pitched in different parts of the district south-east of Maple Creek most convenient to the several irrigation schemes. The work lasted until October 30, when the equipment was packed away in the storehouse at Maple Creek.

DESCRIPTION OF DISTRICT.

The extent of the district, topography of the land and characteristic features of the valley have been fully dealt with in previous reports.

DESCRIPTION OF WORK.

The work of the season was practically of the same routine nature as that of the past seasons and consisted in the personal inspection of all irrigation schemes, the surveying of certain schemes for data for the preparation of amended detail and general plans and right of way plans, the installing of gauge rods, giving grade stakes for ditches, dikes, etc., and in the securing of, and giving, as much information along irrigation lines as possible. The last is really one of the inspectors most important duties.

PRELIMINARY RESERVOIR SURVEYS.

As the above work was hardly sufficient to keep every man in camp busy, I had the assistant make several preliminary reservoir surveys which looked feasible to the eye. In this way two or three good locations were found upon streams where the storage of the flood waters is very important. A special report will be submitted later regarding these. Several days were spent by myself with a democrat and a saddle-horse reconnoitering the several drainage basins for possible reservoir sites and, although I believe that I have located every feasible site besides those previously located, further investigation and surveying may discover others. The construction of reservoirs in this district, where the run-off period is of such a short duration, is so necessary for the fullest development of the large irrigable flats in the stream valley, that more time should be given to this work than has been devoted to it in past seasons.

RIGHT OF WAY SURVEYS.

The recent ruling requiring right of way plans for all works upon Crown lands has caused a great deal of extra office and field work. To make a right of way survey of a ditch requires, in many cases, three or four times as much work as an ordinary ditch location survey, as for example, three-quarters of a mile of ditch required four and one-half miles of chaining for its proper location with respect to all lines of the section.

GAUGE RODS.

A few gauge rods were installed this season. From four year's observations I can see that it is going to be a very difficult matter to obtain even a fair amount of reliable records. One reason is, that in many cases the rods are a considerable dis-

tance from the irrigators' houses; another is that human failing which makes most people reluctant to do something for nothing. A few records will be obtained and submitted by some persons for their own protection, and a few will be submitted by some interested progressive water-users, endeavouring to co-operate with the department in securing information which will be of service to the community. Unfortunately these records will not include very many ditches. At the present time I do not consider it a wise plan to attempt to coerce anybody into submitting records, as the instant such attempt is made considerable antagonism will be caused among many of the water-users, resulting in more evil than good. Until irrigation is more fully developed the securing of ditch records should be confined mainly to those watersheds in which friction is apt to arise between the several water-users, and to those schemes which are very suitable for the obtaining of accurate information in regard to the duty of water, etc. I have dealt quite fully in my 1912 report with the best methods of constructing gauging devices in ditches for Maple Creek conditions.

PHOTOGRAPHS.

Photographs were made of all important structures and of as many good crops grown under irrigation as I was able to observe. In this connection it might be a good plan to make lantern slides of a few good structures, successful crops of hay and grain, and of anything else that might be interesting from an irrigation standpoint. Arrangements could be made to show these in Maple Creek at one of their summer irrigation meetings. Such an illustrated talk should be very instructive.

AREAS IRRIGATED IN 1914.

The following is a table showing the amount of land irrigated in the summer of 1914:—

——	Total Irrigated Area.	Irrigated in 1914.	Per cent.
Licensed	25,764	11,009	72
Unlicensed	9,556	950	10
Total	35,320	11,959	34

A large part of the land was only irrigated once in the spring by flood water, resulting in a very low yield, very much below the average. A great deal of water would have been used in June and July had it been available. This is taken up more fully in my crop report.

SUMMARY OF SEASON'S WORK.

Period of field work: May to October 30.

Number of work days	157
Total number of days actual work	150
" " irrigation inspections	96
" " irrigation schemes	94
" " licensed irrigation schemes	78
Number of ditch gaugings made	12
" ditch gauge rods installed	7
" miles of traverse	58
Plans submitted, amended general	5
" amended detail	5
" new schemes	1
" right of way	16
" reservoir	7
Number of miles travelled by democrat	2,016
" " train	150

WESTERN MAPLE CREEK IRRIGATION DISTRICT.

REPORT OF H. R. CARSCALLEN, INSPECTING ENGINEER.

CALGARY, ALTA., February 8, 1915.

I have the honour to submit herewith my report on the work done in the western Maple Creek district during the season of 1914.

The early part of the season from the 16th of March to the 27th of April was spent on the collection of hydrometric data of the spring run-off, with headquarters at the Tenmile Police Detachment. During this time several special inspections were made.

Camp was set up near Maple Creek on the 1st of May for the purpose of assembling equipment, getting horses into good working order, etc. The first working camp was pitched on Cypress creek, sixteen miles southwest of Maple Creek, on the 13th of May, and the regular inspection work for the season was started. Eight different camps were used during the season in carrying on the work.

The camp outfit was trailed to Maple Creek from the camp near Manyberries, Alta., arriving there on the 6th of November. The equipment was stored in Maple Creek, and five of the eight horses taken out to winter pasture. The remaining three horses were used in completing the season's inspection work, which was done by means of democrat and team with the aid of one man. Field work was concluded on the 14th of December.

The following schedule summarizes briefly the work done in the district during the past season as well as tabulating other points which may be of interest:—

Period of field work: May 1 to December 14.	
Number of work days	195
" days actual field work	176
" days unsuitable for field work	19
Total number of irrigation inspections made	119
Number of irrigation schemes in district, total	93
" " " licensed	62
" " recommended for license in 1914	12
" new applications	15
" applications for additions to old schemes	2
" ditch gauge rods established	14
" miles of traverse survey	112
Plans submitted, amended general	17
" amended detail	15
" new schemes	9
" right of way	9
Number of miles travelled by democrat	3,932
" " train	126

The manner of carrying on the work during the season was quite similar to that used in previous years, which has been described in previous reports and need not be repeated here.

Generally speaking, good progress has been made in construction work throughout the district during the past year. As shown above, twelve schemes were recommended for licenses. In addition, several more schemes were nearing completion and should be finished up early next season. It is anticipated that by the end of the summer of 1915 very few of the authorized schemes will remain unlicensed. The good progress shown is due in part to the fact that crops generally were almost a total failure and a great deal of extra time, in consequence, was available for working on the schemes.

Another effect of the very dry season was to give a very noticeable impetus to irrigation in the district, since those who were in a position to divert even the small quantities of water available were the only men who realized anything whatever from their land. This is especially evidenced in the Pakowki Lake district by the exceptional number of new applications for water rights sent in from that part of the country; there were fifteen of these, in all, and the greater number of them are located in that neighbourhood. The fine appearance of the meadows owned by Messrs. Hooper and Huckvale, Mr. E. F. Harms and Mr. Daniel McLean and the yields therefrom have given the dry farmers in the district excellent object lessons on the benefits of irrigation and has resulted in the fifteen new applications referred to.

Unfortunately the water supply in this district is extremely limited, and on that account some of these applicants had to be refused. Most of the streams are already licensed to their full capacity. However, from the results being obtained from the duty of water investigations being carried on at present, as well as from personal observation of good results being gained from the application of a very small percentage of the amount prescribed it seems quite evident that the present duty of water has too high a value. In the event of this proving true and the duty of water being adjusted accordingly there will be a considerable amount of water available for irrigation purposes. Much of the run-off in all the streams in the district is going entirely to waste, due to the fact that it comes down in such a very short period of time in the spring of the year. On this account efficient reservoiring facilities are wanted very badly and this need is becoming more and more pressing as more and more land is being brought under irrigation.

As the greater part of the survey work in the eastern district has been finished up it is proposed to add to that district a strip of territory lying along the eastern boundary of the district in order that the work in the two districts may be more equally divided. This will be found to be a great advantage in working the western district the coming year, as the schemes taken in at the latter part of the season, viz., those in the west and northwest of the district, may be given better attention than could be given them in the past owing to the lack of time and the lateness of the season when these schemes were visited.

There are still a number of the older schemes in the district for which the plans on file are very crude and fall considerably below the standard now required. These plans require amendment as soon as possible and the survey work involved in the collection of data for amended plans is considerable. There is more than sufficient of this work remaining to be done in the district to warrant the maintenance of a party of the same size and equipment as has been operating there during the past two seasons.

CALGARY IRRIGATION DISTRICT.

REPORT OF R. H. GOODCHILD, INSPECTING ENGINEER.

CALGARY, ALTA., December, 1914.

I have the honour to submit, herewith, the general report of work done in the Calgary irrigation district during the season of 1914.

As mentioned in previous reports, this district comprises the territory lying between the Macleod section of the Canadian Pacific Railway on the east, and the Rocky mountains on the west, and between townships 3 and 28.

I commenced outside work on April 28, and on November 19, by which time I had reached High river on the return trip, I was obliged, on account of very heavy falls of snow, which made travelling in the hilly country very difficult, to abandon the small amount of work still remaining, and to store the outfit and turn out the team for the winter at a nearby ranch. I arrived in Calgary on November 19, having spent six months and three weeks in the field.

During this time I inspected all but one of the schemes in my district, and made nineteen re-inspections. My familiarity with the trails and with the different schemes which I had visited, made progress more rapid and easier than last season, and resulted in my saving several hundred miles of travelling.

The past season was exceptionally dry, with the consequent result that quite a lot of rush work was done on many of the schemes, in the effort to bring them to a state of higher efficiency.

A series of wet years in the district is not an altogether unmixed blessing, for it results in many of the licensees losing sight of the value of their irrigation works during these wet years, and in consequence a dry year finds many of the schemes not in shape for immediate use, and there is a resultant loss to the owners through their inability to irrigate to good advantage.

It is, however, encouraging to note that more interest was taken this season in irrigation matters throughout the country, and I anticipate that next season will show a considerable increase in the acreage under irrigation. This increased interest is probably partly due to the dryness of the past season, but it is also caused to a certain extent by the marked success which has attended the efforts of those who have irrigated properly and carefully.

The work done in this district during the past season may be summarized as follows:—

Inspections made	109
Re-inspections made	19
Total	128
Miles travelled—	
By trail	1,648
By rail	492
Total	2,140
Stream gaugings made	12
Traverses run	5
Right of way plans prepared	3
Amended general plans prepared	4
Detail plans prepared ..sets.	5

The schemes in this district may be classified as follows:—

Irrigation schemes	100
Domestic	3
Municipal	4
Industrial	2
	109

The condition of the irrigation schemes this season was found to be as follows:—

Number of licensed schemes	89
" schemes in shape for licenses	4
" " under construction	6
" " in bad condition	9
New—	
New applications reported feasible	1
New applications reported not feasible	2

The time taken for the work was made up as follows:—

April 28 to November 19, inclusive	206 days.
Sundays	29 "
Days lost through bad weather	14 "
" " other causes	7 "
" spent on inspections and travelling	156 "
	206 "

REPORT ON SPECIAL INSPECTIONS.

REPORT OF P. J. JENNINGS, OFFICE ENGINEER.

CALGARY, March 27, 1915.

I have the honour to submit the following report upon the work done by myself and under my supervision during the season of 1914.

SPECIAL INSPECTIONS.

Under the reorganization of 1913 the duties of office engineer and senior special inspecting engineer were combined, the supervision and direction of all special inspections being undertaken by the office engineer. This system of decentralization was tried out in the latter part of 1913 and proved the most satisfactory way of keeping this work checked and up to date.

The regular staff engaged on this work comprised two qualified civil engineers, both having some previous experience in this class of work. Additional assistance was given by Mr. A. W. P. Lowrie and by myself as circumstances required.

The actual number of inspections made this year has not been as great as in previous years, but those made were of a very widely scattered nature, requiring a great deal of detailed information, only procurable by actual survey. This applies particularly to the inspections carried out by Mr. Burfield in connection with proposed reclamation by drainage of certain large tracts of land in Saskatchewan and Alberta. The inspections of this nature in Alberta were made as far west as Grand Prairie Settlement, in township 71, range 7, West of the 6th meridian.

SCHEMES FOR RECLAMATION BY DRAINAGE.

Approximately four months of the season were taken up by one engineer in investigating and preparing reports in connection with drainage reclamation schemes. The number of schemes of this nature, which usually requires a great deal more field work than the average special inspection, is increasing every year. Had it not been for the temporary assistance given by Mr. Lowrie, during twenty-six days in October, which relieved the pressure on Mr. Chambers, it is doubtful whether the outside work would have been finished before the close of the field season.

For the inspections in the Peace River district, pack horses were used for the journey west from Grouard, a slow method of travel, but under the existing conditions, the most satisfactory. Five inspections were made, and the time actually occupied in travel and on survey was fifty-seven days.

The investigations and reports in connection with Ponass Lake (Saskatchewan) reclamation took up some eight weeks of Mr. Burfield's time. This work with its various ramifications covered a very large area of country and necessitated a great deal of preliminary survey work. The swampy nature of the country impeded progress, and the use of a boat for getting from one point to another was frequently necessary.

Inspections and reports have been made of schemes dealing with the lowering of lakes for the benefit of adjacent owners. In some instances it has been found that great hardships have been imposed upon settlers by the damage done to low-lying hay meadows, through the overflowing beyond their surveyed borders of lakes and sloughs, particularly in the brush country. Such hay lands are often the only places where hay can be cut within a reasonable distance of their homesteads. This state of affairs is generally brought about by one or all of the following causes:—

(1) The illegal diversion of other small bodies of water.
(2) The silting up of outlet channels.
(3) Abnormal rainfall.

The question of lowering the water to relieve the situation thus created is one with very far-reaching effects. Unless the whole district drainage system is thoroughly investigated and studied and a proper and sufficient natural outlet channel is available, the question cannot be economically handled, unless by mutual arrangement with the owners of all the lands affected. It is of course an easy matter to lower or remove the water of one lake by turning it into another, but this is not at all a satisfactory system in the majority of cases, as it usually results in raising the level of another lake or chain of lakes.

The loss of evaporation surface by drainage operations is a point for serious consideration. There will always be an additional area of land over which the water must spread until it has covered a sufficient additional area to gain, as it were, a state of equilibrium by evaporation.

It is thought likely that the work in connection with drainage reclamation will increase during the coming years. In this event it would be advisable to consider the appointment of another engineer, either to assist generally on special inspections or to work exclusively on drainage investigations. The work, however, has hardly arrived at the stage where the services of a qualified engineer could be used exclusively. Until such time arrives the greatest efficiency, consistent with economy, will be obtained by continuing the present arrangement.

SUMMARY OF THE WORK DONE.

During the season 139 inspections have been made; they can be graded under the following heads and the numbers given under the name of the engineer who did the work.

—	Mr. Chambers.	Mr. Burfield.	Mr. Lowrie.	Mr. Jennings.
Domestic	14	14	0	0
Municipal	10	5	0	2
Industrial	16	10	5	1
Irrigation	21	5	1	1
Other	8	5	3	5
Reclamation by drainage	2	6	4	1
Total	71	45	13	10

PLANS.

A great deal of difficulty has been experienced during the past year in getting sufficient information upon plans submitted for approval by applicants for rights under the Irrigation Act. This not only causes unnecessary correspondence but a great deal of delay in getting the application in acceptable form for authorization. The schemes which usually give the most trouble are those which include a dam for the creation of an impounding reservoir. These schemes nearly always affect areas of private land. Safeguarding these private interests by insisting upon the acquisition of a sufficient

area for right of way is usually the chief source of trouble. In cases where sufficient hydrometric records are available the trouble is due to poor design in connection with the dam, the spillway and sluiceway areas seldom being of sufficient capacity. The return of such plans for amendment and further information not only causes delay, but involves unnecessary expense to the applicant.

The cause of the trouble, it is thought, may be due to the need of a simple form of instructions, outlining specifically the requirements of this office for plans which will be acceptable, both as regards detail and general get up, for the various methods used for the diversion and use of water. These forms could be sent out to applicants and especially to engineers of railways, cities and towns submitting plans. Such a form is being drawn up and will be duly submitted for consideration and approval.

Necessity has from time to time arisen for the acceptance of plans, not entirely satisfactory, in order that the applicant's priority might be maintained and an undue hardship avoided. This course of procedure has only been necessary in a few cases and after good and sufficient reasons have been submitted. One case in point was that of a municipal body which found it impossible to finance and consequently construct its works at the present moment, but which was desirous of holding its right.

The course followed in such cases has been to accept these plans as "preliminary" only.

OTHER ROUTINE WORK.

During the year an endeavour has been made to collect more definite and complete records than are at present available in connection with municipal water supplies, such information to be used primarily for determining the basis of quantity per capita in the issue of licenses for "municipal purposes."

A form was prepared on which the daily quantities could be conveniently entered and summarized for each month. Copies of this form were sent out to forty cities and towns in Alberta and Saskatchewan which were known to be water users under the provisions of the Irrigation Act. Up to date the following result has been obtained:—

1. Eight have returned completed forms.
2. Fifteen have advised that forms will be completed.
3. Seven were unable to furnish any of the information as they have no metering system.
4. Ten have not replied at all.

This may not at first appear to be a very good return for the trouble which has been taken in the matter. With twenty-three sets of complete records it will, however, be possible to arrive at a very fair average daily consumption figure and place us in a position to gauge the quantity required per capita on a more equitable basis.

During the year the following plans have been examined and approved:—

1. For domestic purposes	7
2. For municipal purposes	34
3. For industrial purposes	66
4. For irrigation purposes	111
5. For other purposes	1
6. For drainage reclamation purposes	5
7. For right of way purposes	31
Total	255

CHARLES CHAMBERS, INSPECTING ENGINEER.

CALGARY, January 28, 1915.

This work necessitated a great deal of travelling throughout the provinces of Alberta and Saskatchewan between the 11th March and 12th November, 1914. The essential details are concisely shown in the following tabulation.

SCHEDULE OF SCHEMES INSPECTED AND SURVEYED.

Seventy-one schemes were inspected by the undersigned during the year 1914, divided into different classes according to the following table:—

	Methods employed.			Totals
	Gravitation.	Pumping.	Impounding.	
For Domestic purposes			14	14
" Municipal "		10		10
" Industrial "		16		16
" Irrigation "	17	4		21
" Other "	3		7	10
Totals	20	30	21	71

Right-of-way surveys were made of 4 schemes.

An ordinary survey was made of 1 scheme.

Plans were prepared for 12 schemes.

The cost of construction was estimated for the works of 2 schemes.

The first inspection of the season was made on the 11th of March and the last on the 12th November, 1914.

The season comprised, working days	206
Number of days actual work were—	
In field	151
In office	55
Number of miles of traverse survey	15
Number of miles travelled by democrat	2,240
Number of miles travelled by train	9,560

REPORT OF F. R. BURFIELD, INSPECTING ENGINEER.

CALGARY, January 23, 1915.

I have the honour to submit herewith my report on work done during the field season of 1914.

From March 7 to April 6 I was in charge of hydrometric work in the Macleod district. On April 14, I left Calgary for my first tour in connection with "special inspections." The schemes inspected on this trip were with one exception in the eastern part of Saskatchewan. The exception referred to was an investigation which was made into the possibility of intercepting the drainage from the northern slope of the Riding Mountain forest reserve in Manitoba, which at present floods the adjacent land. In this investigation I received great assistance from Col. Stevenson, Superintendent of the reserve, for which I should like to make acknowledgment.

For about a month I was engaged upon a survey to determine the desirability and feasibility of draining Ponass lake in northern Saskatchewan. This involved

consideration of the provision of an outlet from Quill lakes to Last Mountain lake, but owing to my being required for other work I was unable to take sufficient levels to make an estimate of the cost of this outlet. A survey for this purpose has subsequently been made by the Highways Commission of the Saskatchewan Government.

The rest of the trip, which concluded on the 10th July, was occupied by inspections and surveys of various small projects.

The ground covered on my second tour was northern Alberta; this trip was chiefly taken up with inspections of drainage projects. I left Calgary on July 17 and proceeded to Athabaska, near which the first inspection was made. I then travelled by water to Grouard and drove to Round lake, from which point an investigation into the desirability of draining Round and Winagami lakes was made. Returning to Grouard I got together a small party and made a survey at Winagami lake. We then left on a trip to inspect several schemes; the route followed was via Sturgeon lake to Puskwaska lake, thence to Grande Prairie and from there to Egg lake via Spirit River settlement. The return to Grouard was made across the Big Smoky river and by Round lake. The tour concluded by my return to Calgary on September 27.

An interesting question is, what time of the year is best suited for making these drainage inspections? For obvious reasons, the desirability of a scheme ought to be investigated during the open season; it is very difficult to form any idea of the necessity for drainage after the ground is frozen and covered with snow. The winter presents advantages for making a survey to prepare plans and estimates; soundings can be taken through the ice and their location accurately determined, and the work of levelling down a swampy outlet is facilitated. It is, however, usually necessary from motives of economy that both inspection and survey should be made at one visit. The shortness of the days, the unsettled country, the difficulty of obtaining horse feed are also strong arguments against winter inspections.

A matter which deserves consideration is the extent to which erosion as an excavating agent should be permitted; from the point of view of a party wishing to drain lands as cheaply as possible it has obvious advantages. Where the discharge is into an outlet capable of receiving the silt, there seems no reason why it should not be permitted, but in sluggish streams it may choke the channel and do much damage. It also has the disadvantage of being difficult to control after the required cross-section is reached, and of producing banks which have not a stable slope.

One of the difficulties met with in designing schemes for drainage purposes is the absence of reliable data regarding run-off in northern Alberta and Saskatchewan. Conditions in this part are different from those prevailing on the prairies, and some records of run-off and particularly of flood run-off from various sized drainage areas would be useful.

Another difficulty met with in inspecting private drainage schemes is that they usually form part of a larger drainage area and it is therefore necessary to take into consideration the larger area when designing a scheme.

In a number of cases it is not economically feasible to design a scheme capable of entirely preventing flooding in the area under consideration. This should not be allowed to prevent the carrying out of a less efficient scheme, which in cases where drainage is desirable is very much better than no scheme at all.

My third and fourth trips were in Saskatchewan; a number of small schemes were inspected.

The question of reservoirs for impounding water for domestic purposes in small creeks on the prairies has assumed some prominence during the past year. Several complaints regarding dams both authorized and unauthorized were investigated. As a rule these complaints were found to be based on very flimsy grounds.

If a census could be taken of all these dams constructed on the prairies to impound water for domestic purposes, they would probably run well into the thousands.

Many of the owners of these reservoirs are ignorant of the fact that a license is required for their maintenance, and those who know are disinclined to go to the trouble and expense of obtaining one.

There can be no doubt that it is desirable that there should be some regulation of these reservoirs by this branch. Section 23 of the Irrigation Act provides that at the discretion of the Minister of the Interior, applicants for water for domestic purposes may be granted licenses on filing a memorial only. In my opinion such a procedure might be adopted with advantage in connection with these small reservoirs. Most of them are small, and the dams are of a temporary character, renewable from year to year, and I think that the expense of a separate inspection, survey, and preparation of plans for each is too great to be warranted.

The quantity of water could be based on the requirements of the applicant, determined either by acreage or by the stock owned by him, with an allowance for evaporation, instead of on the capacity of his reservoir; such a procedure would in my opinion be more in accordance with the spirit of the Irrigation Act. If there is any doubt as to the quantity of water available, a general inspection of the creek could be made, and all the dams authorized and unauthorized noted, when a comprehensive scheme for dealing with them could be adopted.

The folllowing is a summary of the work done on each trip.

Trip.	Miles travelled.			Gaugings.	Inspections.
	Train.	Trail.	Water.		
Hydrometric, March 7 to April 6	905	277		35	
Special inspections—					
April 14 to July 10	3244	766			14
July 17 to September 27	649	672	270		7
October 19 to November 14	1952	202			9
November 15 to December 16	2089	416			13
Totals	8839	2333	270	35	43

Number of days in field (including Sundays) 250
Number ot days in field (including Sundays) on special inspections..... 219

The inspections made were divided as follows:—

Domestic	14
Municipal	5
Industrial	9
Irrigation	5
Other (including six drainage)	10
Total	43

Surveys were made in connection with ten of these.

REPORT OF B. RUSSELL, CHIEF FIELD INSPECTOR.

CALGARY, March 24, 1915.

I beg to submit herewith my annual report of the work carried out under my supervision during the year 1914.

OLDMAN RIVER IRRIGATION PROJECT.

A full description of this project will be found in the annual report for the year 1913. This, as the name implies, contemplates the diversion of water from Oldman river for the irrigation of several detached tracts of land north of the city of Lethbridge in southern Alberta, the total area of which is approximately 100,000 acres.

Portions of the district comprised in this project have suffered severely from drought in recent years, and particularly in 1914, and the settlers have urged upon the Government the completion of the surveys and the actual construction of irrigation works. Preliminary survey work was undertaken in 1913. Further surveys were made during 1914 and a fairly close estimate of the irrigable areas and cost of constructing a system of canals will be found in the report submitted by Mr. V. Meek, B.Sc., who had charge of the party engaged upon this work.

Considerable interest has been taken in this project by the occupants of lands under the proposed system, particularly in that section of country in the vicinity of Iron Springs, and as a result of petitions by interested parties it has been considered advisable to make plane table surveys during the coming season to determine as accurately as possible the irrigable area.

Although there were some petitions filed by farmers in the vicinity of Barons against the construction of this scheme, there is good reason to believe that these farmers misunderstood the advantages of irrigation to them, and that they now favour the construction of it. It seems that until lately the erroneous impression has been, in the vicinity of Barons, that in the event of the project costing at the rate of say $20 per acre, their lands will be taxed to this amount, whether the water reaches them or not.

FURTHER POSSIBILITIES.

There are several possibilities in connection with this project which, although at the present time not apparently feasible, should be mentioned in this report. It will be seen that in order to utilize Keho lake for storage purposes, a heavy cut both into and out of this lake is necessary. It is possible that instead of utilizing this site for storage it might be found more feasible to create storage on the Oldman river and thus abandon the Keho Lake reservoir site. There are at present two known sites on the Oldman river in which a considerable quantity of water could be stored. One is at the "Gap" through the Livingstone ridge on the North Fork, and the other is in the lakes at the head of the Crowsnest river.

Both of these sites are at a very great distance from the irrigable areas, and it is considered that there would be difficulty in operating them in connection with this project. The location of Keho lake with regard to the land is about the best location for a storage reservoir from which to supply water to the lands, and unless the most suitable duty of water for the areas under consideration is eventually determined to be lower than that adopted by Mr. Meek in his discussion of the project it will probably never be found feasible to construct reservoirs on the Oldman river.

The net duty of water taken by Mr. Meek in designing this system is twenty-two inches, while the legal requirements in this country is an amount corresponding to two feet over the land. Even with this lower duty of water, two acre-feet per acre, there is sufficient water in the Oldman river, with the exception of the driest years, to irrigate all of the land considered to be susceptible of irrigation. The canals have been designed of sufficient capacity to handle the water according to practical requirements.

There is a possibility of extending the Oldman River project across the Little Bow river to the Sundial country. A long flume or syphon across the Little Bow river would be required to carry the water to these lands, and large storage reservoirs would have to be created at some point on the system in order to utilize a large amount of the flood discharge. The question of how much land could be irrigated from the Oldman river and the amount of storage required depends altogether upon the duty of water which will eventually be adopted for this land.

If in constructing this scheme it is necessary to comply with the legal requirements it is not likely that there will be any water available for the lands in the Sundial district. It is believed, however, that a very much higher duty of water than two acre-feet per acre will be adopted before such a scheme will be put into operation;

and in this event, with the additional storage capacity available at various points throughout the system, it might very well be found feasible to extend the system to take in the irrigable lands in the Sundial district.

It was thought at the beginning of last season that, although the farmers in the vicinity of Iron Springs would favour the construction of the Oldman River irrigation project, those toward the west of the tract would not be so disposed. Mr. Meek was accordingly instructed in connection with his surveys to look into the possibility of diverting the Oldman river at a point below the town of Macleod and carrying the water directly to the Iron Springs country. It was found, however, upon investigating this scheme that there was no possibility of diverting the river lower down, and this scheme was abandoned.

Mr. Meek has written a full report upon this project, submitting estimates of cost of the project. Although the canal routes have not been accurately located in the field as yet, and no accurate cross-sections made, it is believed that the estimates for excavation are very close. Designs have been made of all the structures necessary, and although these have not been gone into in any great detail as yet, from comparisons with similar structures on the large projects constructed in southern Alberta it would appear that these estimates are fairly close.

MILK AND ST. MARY RIVERS SURVEYS.

The primary object in making surveys in connection with a scheme to irrigate lands tributary to the Milk and St. Mary rivers, south and east of the Lethbridge-Coaldale district, was to determine the irrigable areas in Canada tributary to these two streams, as well as to determine the most feasible system of canals to divert water to these lands. This information was necessary in connection with the administration of the International Waterways Treaty.

Some years ago, when a division of the boundary waters between the United States and Canada was under consideration, Mr. Geo. G. Anderson, C.E., made a reconnaissance of this country and carried out some surveys for diversion canals and storage sites. It was understood, however, that these investigations were only of a very preliminary nature, and although it was believed that the information submitted by Mr. Anderson in the several reports published by him was generally correct, it was deemed advisable for a more thorough understanding of the many intricate problems involved in considering the most suitable division of the waters of the Milk and St. Mary rivers, to carry out more detailed surveys, not only to check the results of Mr. Anderson's investigations, but to determine other possibilities in connection with an irrigation system which would best serve the irrigable lands in Canada tributary to the Milk and St. Mary rivers.

GENERAL INSTRUCTIONS.

Three parties were engaged upon this work. One party in charge of Mr. T. M. Montague, C.E., was instructed to make the necessary surveys for diversion canals from the rivers, while the other two under the charge of Mr. N. M. Sutherland, C.E., and Mr. A. W. P. Lowrie, C.E., were instructed to run sufficient levels over the land to allow of an approximate estimate of the irrigable areas being made.

Upon commencing these surveys, very little information was available regarding the general elevations of the country to be covered. It was known that there were immense tracts of arable land well suited to irrigation stretching north and south from the Belly river to the Milk river, and east and west (roughly speaking) from range 22 West of the 4th meridian to Fortymile coulee and Pakowki lake. There was no information available, however, to indicate what portions of this immense area it would be physically possible to irrigate provided a sufficient quantity of water was available.

Under these circumstances it was considered advisable, to first establish a reasonably accurate system of levels over the whole of this country, to afterwards select such tracts as could be commanded by a system of canals, and then, by making more detailed surveys of these, to determine as nearly as possible the irrigable areas.

SCHEME NO. 1.

Two possible schemes of diverting the water from the Milk and St. Mary rivers were known to exist. One scheme was to take the St. Mary river water out at a point near the international boundary, to carry it in a canal through Whisky Gap in the Milk River ridge to the Milk river, again diverting this water, together with the Milk River water at a point in tp. 2, rge. 17, W. 4th meridian.

SCHEME NO. 2.

The second scheme was to divert the water at Kimball through the present main canal of the Alberta Railway and Irrigation Company to hold up the grade, and carry the amount of water not required on lands tributary to their present system, in an easterly direction to the tracts farther east instead of allowing it to drop down through natural watercourses, as at present.

Mr. T. M. Montague, C.E., who had charge of the party engaged on this end of the work, was instructed to make a thorough investigation of each of these possible schemes, and to also develop the possible reservoir sites known to exist at this end of the project.

DESIGN OF SYSTEM.

In order to design and lay out a proper system of canals to irrigate the lands under consideration, it will be necessary to first carry out a great many more surveys than has so far been possible, but a preliminary study of such a project has been made from the information so far available, and a discussion of some of the questions which will have to be considered in designing such a system may be interesting.

The three questions to be considered in the design of this system, and indeed in any irrigation project, are the following:—

First.—The irrigable areas, or the amount of land susceptible of irrigation.
Second.—The available water supply.
Third.—The available storage capacity.

DESCRIPTION OF IRRIGABLE AREAS.

It has been roughly estimated that there are 552,296 acres of land in southern Alberta, tributary to the Milk and St. Mary rivers, susceptible of irrigation. Of this amount, 171,296 acres are in the vicinity of Magrath, Raymond, Lethbridge, and Coaldale. The Alberta Railway and Irrigation Company are now irrigating probably 100,000 acres of this, but the remaining 71,296 acres can be irrigated by extending their present system. The large area of some 381,000 acres lies to the south and east of the Lethbridge-Coaldale district and can only be irrigated by greatly enlarging and extending the present system of the Alberta Railway and Irrigation Company.

For convenience in discussing this scheme further, the irrigable areas have been divided and subdivided into tracts, and table No. 1 shows the total and irrigable areas in each of these tracts. If this table and the sketch maps accompanying this report are referred to, there should be no difficulty in following the further discussion here.

TABLE I.

Tract.	Location.	Total Area.	Irrigable Area.	Remarks.
		Acres.	Acres.	
1 "A"	Near Magrath between Pothole creek and St. Mary river	36,480	20,440	Partially irrigated.
1 "B"	South of Magrath and east of Pothole creek	10,240	4,096	
1 "C"	South of Magrath in township 4, range 22	9,600	3,840	
2	Around Raymond	55,760	31,700	" "
3	In Lethbridge-Coaldale district	149,300	104,450	" "
4	South of Raymond—at higher level than tract 2	13,440	6,770	
5 "A"	Between Chin coulee and Belly river below 2700 contour	243,900	123,000	
5 "B"	Between Chin coulee and Belly river above 2700 contour	220,100	84,000	
6	Between Etzikom and Chin coulees	185,000	63,000	
7 "A"	Between Verdigris and Etzikom coulees north of Verdigris lake	81,000	29,146	
7 "B"	Between Verdigris and Etzikom coulees north of Lower Verdigris coulee	127,000	35,232	
7 "C"	Between Milk river and Etzikom coulee west of Pakowki lake	135,000	26,622	
8	Between Milk River ridge and Verdigris coulee	52,000	20,000	
	Total	1,318,820	552,296	

The lands levelled over last season by Messrs. Sutherland and Lowrie are all in tracts 5, 6, 7, and 8, but as the reports of these officers are not to be published it will be advisable here to describe briefly each of these tracts as well as tracts 1, 2, 3, and 4, before discussing the various possibilities of irrigating them.

GENERAL DESCRIPTION.

The topography and character of the soil throughout this large area of country varies greatly, but although there are local ridges, buttes, coulees and depressions throughout, the general slope is towards the northeast. Probably the topographical features of this country which present the most serious obstacles to an irrigation system are the three wide and deep coulees which, heading toward the western limit, traverse the tracts in a southeasterly direction.

VERDIGRIS COULEE.

Verdigris coulee practically heads at New Dayton and runs into the Milk river at section 11, township 2, range 14, W. 4th meridian. It is true that a local height of land between Tyrrell lake and Verdigris coulee proper causes a large amount of the run-off from the Milk River ridge to flow by way of a coulee to Tyrrell lake, but the only outlet to this lake is over this height of land to Verdigris coulee and thus to Milk river.

Verdigris lake, as the name would imply, is a large alkali slough containing very little water in the wettest years. This lake forms an admirable site for storing an immense body of water.

Tyrrell lake, owing to the fact that except at high stages it has no outlet, contains a large body of fairly good water all the year round. The shores of this lake are sandy, and the water is considerably better than that found in other parts of the coulee. Although no surveys have as yet been made of this lake, it is believed that a large body of water can be stored here.

ETZIKOM COULEE.

Etzikom coulee is the continuation of Kipp coulee which heads about sec. 12, tp. 4, rge. 21, W. 4th meridian, in the Milk River ridge. Near Stirling this coulee opens out into the large flats in which Stirling lakes are situated, or rather the watercourse

of Kipp coulee runs through these flats near the town of Stirling. No water from Kipp coulee, however, runs into the Stirling lakes; the natural drainage of these lakes is into Kipp coulee. By cutting through from the east end of Stirling lakes to Kipp coulee, probably a distance of less than one-half mile, these lakes could be drained and the land reclaimed.

Toward tp. 6, rge. 18, W. 4th meridian, Etzikom coulee becomes deeper, and from there to Pakowki lake is similar to Verdigris coulee except that the slopes are more broken and rough. In tp. 5, rge. 13, W. 4th meridian, this coulee opens out into what is known as Crow Indian lake but locally called Kings lake. This lake generally contains a large body of good water and is fed partly from the overflow of the irrigation system of the Alberta Railway and Irrigation Company. The lake could hold an immense body of water, but it is not feasible as a storage reservoir in connection with this project.

Etzikom coulee finally terminates in a large slough known as Pakowki lake or Bad Water lake. This lake has no outlet and is twenty-three feet lower than the Milk river at its nearest point.

CHIN COULEE.

Chin coulee is the widest and deepest coulee of the three. As will be seen from the sketch map submitted with this report, it heads at a height of land in sec. 26, tp. 8, rge. 18, W. 4th meridian, and flows both ways, viz., to the Belly river in sec. 17, tp. 10, rge. 17, W. 4th meridian, and to Fortymile coulee near the lower end of Long lake.

Chin coulee is very similar to the others. It is considerably deeper, however, and the slopes are very abrupt. There are a great number of short but deep cross coulees running into Chin coulee at various points throughout its course.

These three coulees and other topographical features divide the country naturally into the tracts shown in table 1.

Tract 1 A.—As will be seen from the accompanying maps, this tract lies between Pothole coulee and the St. Mary river. A small area of this, about 5,440 acres, is now being irrigated by the Alberta Railway and Irrigation Company. The remainder can be irrigated from an extension of the present canals.

Tract 1 B.—None of the land in this tract is at present irrigated, but it is estimated that 4,096 acres can be irrigated from a diversion canal to the Milk River reservoir.

Tract 1 C.—Although it is estimated that there are about 3,840 acres of land in this tract which could be irrigated, the tract lies in the east half of tp. 4, rge. 22, and above the canals indicated on the sketch maps accompanying this report, so that none of this area can be irrigated from the system of canals proposed. This area could only be irrigated in the event of building a diversion canal to the Milk River reservoir at a much higher elevation than the one proposed in this report. It is believed that the lower line from the main canal of the Alberta Railway and Irrigation Company's system to the Milk River reservoir is the most feasible one to construct, and that it would not pay to build this higher line for the benefit of the irrigable areas in tract 1 C. Mr. Montague in his report deals more in detail with these various routes, and although this is the conclusion arrived at from the information so far available, it must be admitted that as yet there is not sufficient data from which to determine positively that the lower route is the more feasible one.

Tract 2.—A large portion of this tract is now being irrigated by the Alberta Railway and Irrigation Company, and nearly all the remainder could be irrigated by simply extending their canals.

A considerable area of the block, north of township 6, is now covered by the waters of Eight Mile lake. This lake can easily be drained into Etzikom coulee, however, and the land reclaimed.

Tract 3.—This tract comprises all of the land now under irrigation, from the system of canals operated by the Alberta Railway and Irrigation Company, known as the Lethbridge-Coaldale district. A much larger area in this tract, however, can be irrigated from an extension of their system. The estimate of irrigable areas in this tract submitted here, has been made from the contour maps compiled by Mr. J. S. Dennis, when he was connected with this department some years ago. This estimate is believed to be approximately correct.

Tract 4.—This tract is directly tributary to the outlet canals from the Milk river and Raymond reservoirs, and could only be irrigated by extending the present system of the Alberta Railway and Irrigation Company to include these reservoir sites. There is a large area of smooth land, and although the estimate of irrigable area is only an approximate one, it is believed to be conservative.

Tract 5.—This tract comprises a large area of smooth land, including a block of 37,000 acres known as the Taber extension of the Alberta Railway and Irrigation Company. This company has now under consideration an extension of their system to irrigate some 17,000 acres of this block from their reservoir in Chin lake. The proposed intake to their main canal to this block is located in sec. 36, tp. 9, rge. 19, W. 4th meridian and the canal location follows along from there in a southeasterly direction, at an elevation of about 2,700 feet. By extending this canal still farther to the east, a very much larger area can be irrigated.

In order to irrigate lands above an elevation of 2,700 feet, it is necessary to flume Chin coulee. By crossing this coulee at an elevation of 2,900 feet in sec. 26, tp. 8, rge. 18, W. 4th meridian a large area of country, between an elevation of 2,900 and 2,700 feet, could be irrigated from a canal thus constructed.

Considering a strip of country probably between the elevations of 2,900 and 2,800 feet, the country is rolling as far east as range 14, where it flattens out perceptibly. There are a great many dry sloughs in this stretch, which render it difficult to irrigate and a large portion can hardly be said to be good farm land. Very little of this has been cultivated or even occupied. The soil is a stiff clay, except in the slough bottoms where it becomes more nearly a gumbo.

Below an elevation of 2,800 feet the land is much better. The slopes are gentle, a large percentage of the land smooth and well suited to irrigation. Perhaps the best land, not only in this particular tract but in the whole area levelled over by the parties engaged upon this work, is included in the following townships: Tp. 9, rge, 17, W. 4th meridian; tps. 9 and 10, rge. 16, W. 4th meridian; tps. 9 and 10, rge. 15, W. 4th meridian.

The remainder of the land, particularly towards the north of the tract, is nearly all good land and would be greatly benefited by irrigation.

The soil throughout the lower lands is all very similar in character, being for the most part a fairly light clay loam, containing a considerable quantity of sand toward the north of the tract. Along the banks of the Belly river the soil becomes distinctly sandy and there are a number of small sand ridges directly bordering the river banks. These lower lands are well settled and a large percentage under cultivation.

As will be seen from the sketch maps, accompanying this report, the land below the low level canal has been called tract 5A. and that tributary to the high level canal tract 5B.

Tract 6.—The country throughout this tract, generally speaking, is rolling. The slopes are long and unbroken, however, and a fairly large percentage of the land below the elevation of 3,050 feet can be irrigated.

The main canal to this tract will be difficult and expensive to construct. In order to convey the water to this tract it will be necessary to cross Etzikom coulee and it appears, from the information so far available, that a canal from Verdigris lake, crossing this coulee at some place in tp. 6, rge. 16, W. 4th meridian at an elevation of about 3,050 feet will be the most feasible location.

The land in this tract, above the elevation of 3,050 feet, is completely isolated due to its height. There is very little of this, however, that would be suitable for irrigation even if it were possible to get the water to it. It is exceedingly rough and full of local hollows which could not easily be drained. Below the elevation of 3,050 feet the land is not so rough and toward the east end of the tract, probably in ranges 10, 11, 12, and 13 is fairly smooth.

The soil throughout this tract is not so good as that of tract 5. It is for the most part a light clay loam but contains a considerable quantity of gravel. Some portions of the tract are stony, the portions of the townships bordering Crow Indian lake being particularly so. Towards the east end of the tract in the ranges mentioned above the soil is of a fairly good quality and the land would be greatly benefited by irrigation.

This tract is not well settled and by far the larger portion is still virgin prairie. Toward the eastern end of the tract, in the "Foremost" country, there is considerable settlement and a few good farms, but in travelling toward the west, an occasional shack of a homesteader is all that meets the eye.

Tract 7.—The topography of this tract is more varied than that of the two tracts already described. The general slope of the country is toward the northeast, but naturally a small area of country drains to Verdigris coulee and Milk river. The divide between Etzikom coulee and Milk river is very close to the latter. It runs parallel to Verdigris coulee and Milk river at an average distance of probably not more than three miles from these watercourses.

A large area of this tract, viz., that area above an elevation of 3,050 feet, is too high to be served with water. The greater portion of the following townships are rendered non-irrigable on this account.

Tps. 2, 3, and 4, rge. 12, W. 4th meridian.
Tps. 3 and 4, rge. 11, W. 4th meridian.
Tps. 3 and 4, rge. 10, W. 4th meridian.

These townships form the high hills in the "Lucky Strike" country, the highest point being at least three hundred feet above any canal which it would be feasible to operate through this tract. The slopes of these hills are very rolling and rough and broken particularly towards Etzikom coulee and Milk river. Towards Pakowki lake the country flattens out perceptibly and below the elevation of 3,050 feet contains a fairly large percentage of irrigable land. The country to the west of these hills, with the exception of a strip along Verdigris and Etzikom coulees, is fairly smooth land and a large percentage of it can be irrigated.

The soil in this tract, generally speaking, contains more sand than that of the other tracts described and, with the exception of the country in the higher lands around "Lucky Strike," could probably all be described as a sandy loam. Throughout these higher lands referred to above, the soil is much heavier and darker and retains more moisture.

The "Lucky Strike" country is fairly well settled and the best farms are located here. There is also considerable settlement in the north half of township 2, ranges 13 and 14, in the vicinity of Allerston. With the exception of these two sections of country, however, this tract is not yet well settled and only a small portion of it is under cultivation. Under the climatic conditions prevalent throughout this country during the past several years the best soil is undoubtedly in the higher lands, where it is heavier and capable of retaining more moisture. Under irrigation, however, these lighter soils in the lower lands should be very productive.

For convenience in designing canals, tract 7 has been subdivided into 7 A, 7 B, and 7 C. The location of these subdivisions will be seen on the sketch maps accompanying this report.

Tract 8.—This tract would be more correctly described as lands between Verdigris coulee and the main canal from the Milk river. Only a small area at the southeast end has as yet been levelled over, and it is therefore difficult at this time to describe the land in any detail. Toward the southeast end the land is fairly smooth and the soil light. There is a stretch of fairly smooth country in the vicinity of Warner, but the soil here is heavier and, although no doubt the land would be benefited particularly in dry years by irrigation it is not as essential to this land as to that farther south.

With the exception of these two stretches, this tract is rolling, and although other small stretches here and there could probably be irrigated, it is doubtful if it would pay to do so, particularly if in so doing it is necessary to sacrifice the more arable lands to the east of Verdigris coulee.

A greater portion of this tract is, comparatively speaking, at a high elevation, being practically the lower slope of the Milk River ridge. There is considerable more rainfall here than farther east, and the soil is heavier and capable of retaining more moisture than the lands farther east. During average years, with good farming, the land now yields good crops and it is believed that irrigation is not necessary.

AVAILABLE WATER SUPPLY.

A comprehensive study of the available water supply for the tracts described is not possible at this time for the following reasons:—

First.—A definite decision regarding the division of the waters of the Milk and St. Mary rivers, between the United States and Canada, has not yet been given by the International Joint Commission and it is not possible, at this time, to determine the quantity of water to which Canada is entitled from these two streams. As has already been pointed out the primary object of these surveys was to facilitate the settlement of this question.

Mr. R. J. Burley, in his report in connection with some phases of the International Waterways Treaty, has discussed this question of water supply, from the Milk and St. Mary rivers, more fully than is possible here. But since the studies made of a system of canals to irrigate all of the lands susceptible of irrigation, tributary to the Milk and St. Mary rivers in Canada, contemplate utilizing large quantities of water from both the Belly and Waterton rivers as well as Canada's share of the waters of the Milk and St. Mary rivers, it is necessary to discuss this water supply question from a different point of view than that adopted by Mr. Burley in his discussion.

Second.—Although a study of the question of the most suitable quantity of water for the growth of crops throughout the arable lands in southern Alberta is now under consideration by this department, the investigations so far made are not sufficiently advanced to allow of the most advantageous duty of water being finally determined.

Third.—Some of the sources of supply have not been sufficiently investigated, as yet, to determine the feasibility of diverting and utilizing the water.

Fourth.—The stream flow records, particularly of the Waterton and Belly rivers, have not been kept over a sufficiently long period of time to permit of the available quantities of water being determined accurately.

Before any study of the water supply question, in connection with this project, could be made, certain assumptions had to be adopted.

It was assumed that the Canadian share of the flow of the St. Mary river at the international boundary line would be fifty-five per cent of the total discharge of the

river at that point. The curves from which this study has been made were plotted from the records taken at Kimball, Alta., but since very little water runs off to the St. Mary river between the boundary line and Kimball there should be very little error on this account.

The fifty-five per cent is based on figures arrived at by Mr. Burley, and although no assurance can be given that this division will hold, it seems a fair one from Canada's point of view and will at least permit further discussion of the available water supply to be made.

It has also been assumed that Canada's share of the flow of Milk river will be all of the discharge of this river as measured at the Milk river gauging station.

In order to utilize all of her share of the St. Mary river water, it is assumed that the United States, by means of a reservoir at the St. Mary lakes, will take care of the winter flow and the high peak floods of the stream, thus allowing Canada to run off her share of the water through a canal of reasonable capacity during the open water season.

A net duty of water of eighteen inches per acre has been assumed for purposes of this discussion. As stated previously, it is not possible as yet to determine definitely the proper quantity of water to apply to lands in southern Alberta in order to obtain the best results and, although indications are that a higher duty than this might suffice, it is believed that a quantity of eighteen inches is at least a safe one to adopt in designing this system.

The irrigation factor assumed is eighty per cent, or it is considered that only eighty per cent of the irrigable area will be irrigated in any one year.

The manner in which it is proposed to distribute the water is as follows:—

32 days from May 1 to June 1, 2 inches.
60 days from June 2 to July 31, 12 inches.
31 days from August 1 to August 31, 2 inches.
30 days from September 1 to September 30, 2 inches.

The losses throughout the entire system have been estimated at forty per cent, or it is assumed that in order to supply eighty per cent of the land with eighteen inches of water a quantity corresponding to twenty-four inches over this area will have to be diverted from the streams.

Although there was not time last season to make any surveys of a canal route between the Waterton and St. Mary rivers, it is believed that it will be found feasible to divert the Waterton and Belly rivers and utilize these waters in conjunction with the quantity available from the Milk and St. Mary rivers.

The stream flow records for the years 1911-12 and 1913 have been taken as the basis of this study. Records for these three years were all that were available at stations near the proposed canal intakes on the Belly and Waterton rivers so that, in considering the four streams collectively, the same period on the Milk and St. Mary rivers had to be taken.

Mr. Burley has determined from records over a considerable period of years that the average flow of the Milk and St. Mary rivers is as follows:—

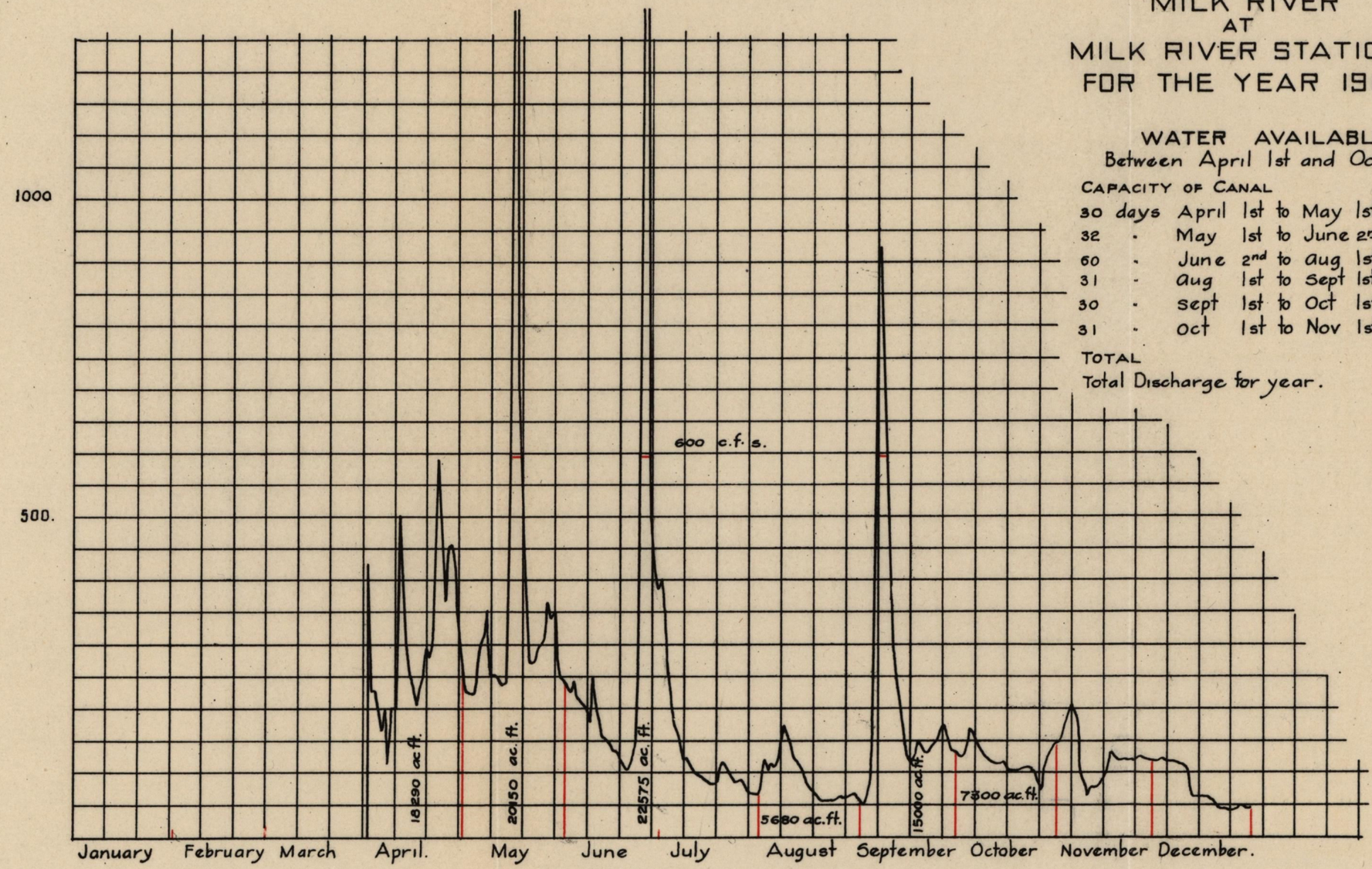
St. Mary river at boundary line, 735,425 acre-feet.
Milk river at Milk River station, 103,000 acre-feet.

It will be seen from the curves from which tables 2, 3, 4 and 5 have been prepared that these average figures correspond fairly closely to the discharge of these streams for the year 1913 which has been considered in this study as an average year. The year 1911 has been considered a high year and the year 1912 a low year.

During years of maxium flow in these streams the discharge is of course much greater, and during years of minimum flow much less, than the discharges for the years 1911 and 1912. These years (if the expression is permissible) may be considered as

I.A.

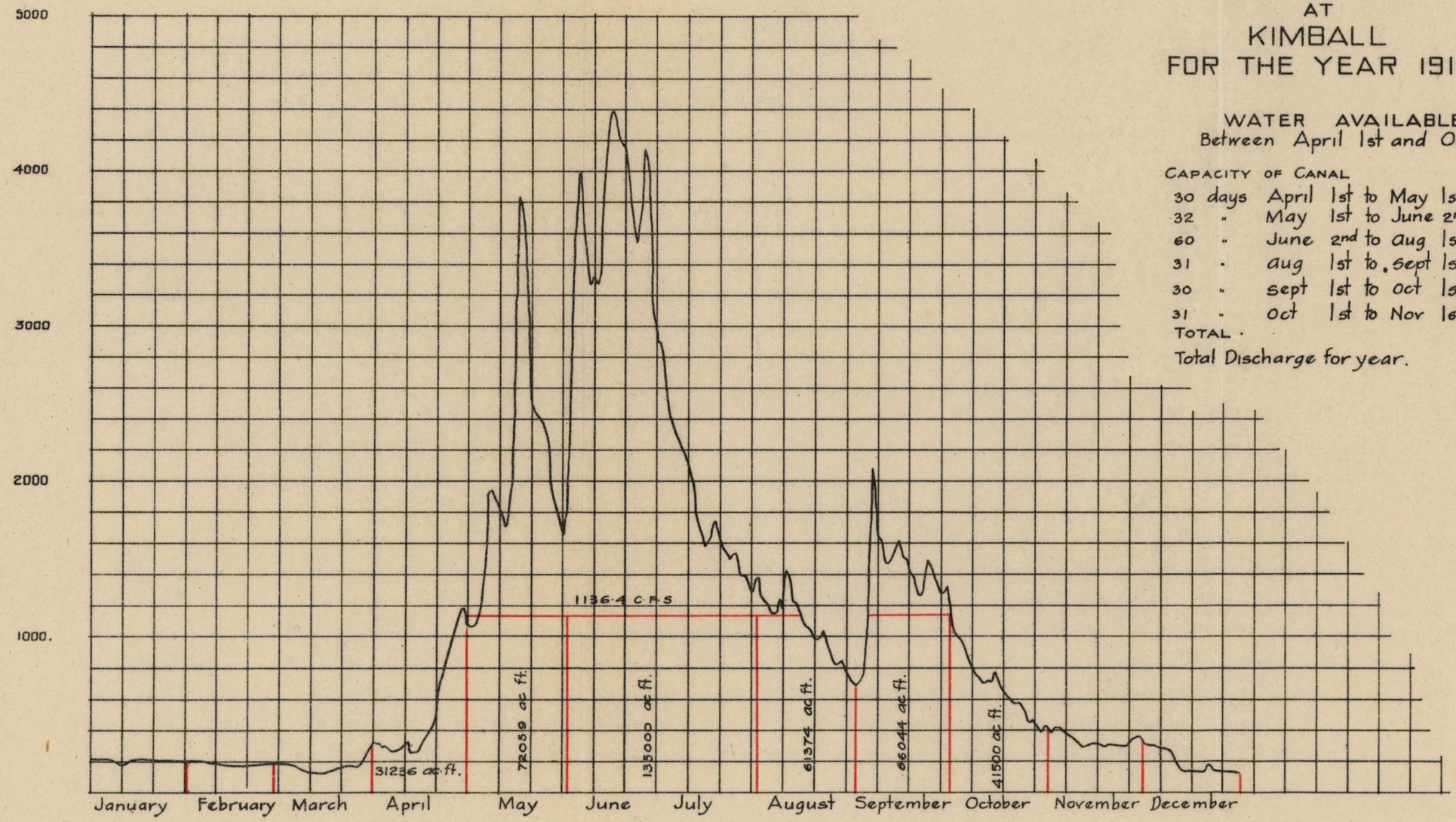
HYDROGRAPH OF MILK RIVER AT MILK RIVER STATION FOR THE YEAR 1911



WATER AVAILABLE
Between April 1st and Oct 31st.

CAPACITY OF CANAL				600	C.F.S.
30 days	April	1st	to May 1st.	18290	ac.ft.
32 -	May	1st	to June 2nd	20150	" "
60 -	June	2nd	to Aug 1st	22575	" "
31 -	Aug	1st	to Sept 1st.	5680	" "
30 -	Sept	1st	to Oct 1st.	15000	" "
31 -	Oct	1st	to Nov 1st.	7300	" "
TOTAL				88995	" "
Total Discharge for year.				113475	" "

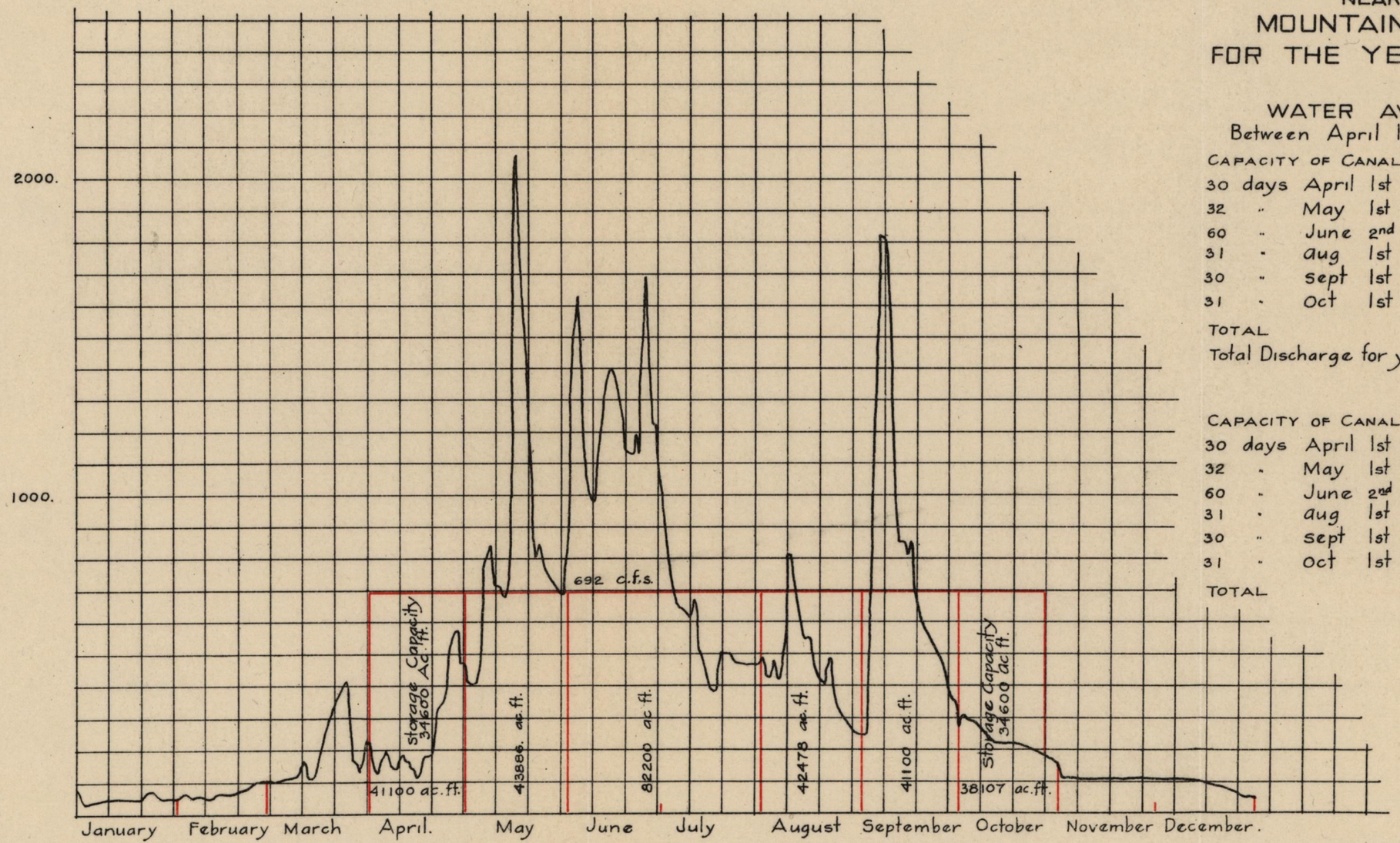
HYDROGRAPH OF STMARY RIVER AT KIMBALL FOR THE YEAR 1911



WATER AVAILABLE
Between April 1st and Oct 31st.

CAPACITY OF CANAL			1136·4 C.F.S.
30 days	April 1st to May 1st	31236	ac. ft.
32 "	May 1st to June 2nd	72059	" "
60 "	June 2nd to Aug 1st	135000	" "
31 "	Aug 1st to Sept 1st	61374	" "
30 "	Sept 1st to Oct 1st	66044	" "
31 "	Oct 1st to Nov 1st	41500	" "
TOTAL ·		407213	" "
Total Discharge for year.		740254	" "

HYDROGRAPH OF THE BELLY RIVER NEAR MOUNTAIN VIEW FOR THE YEAR 1911

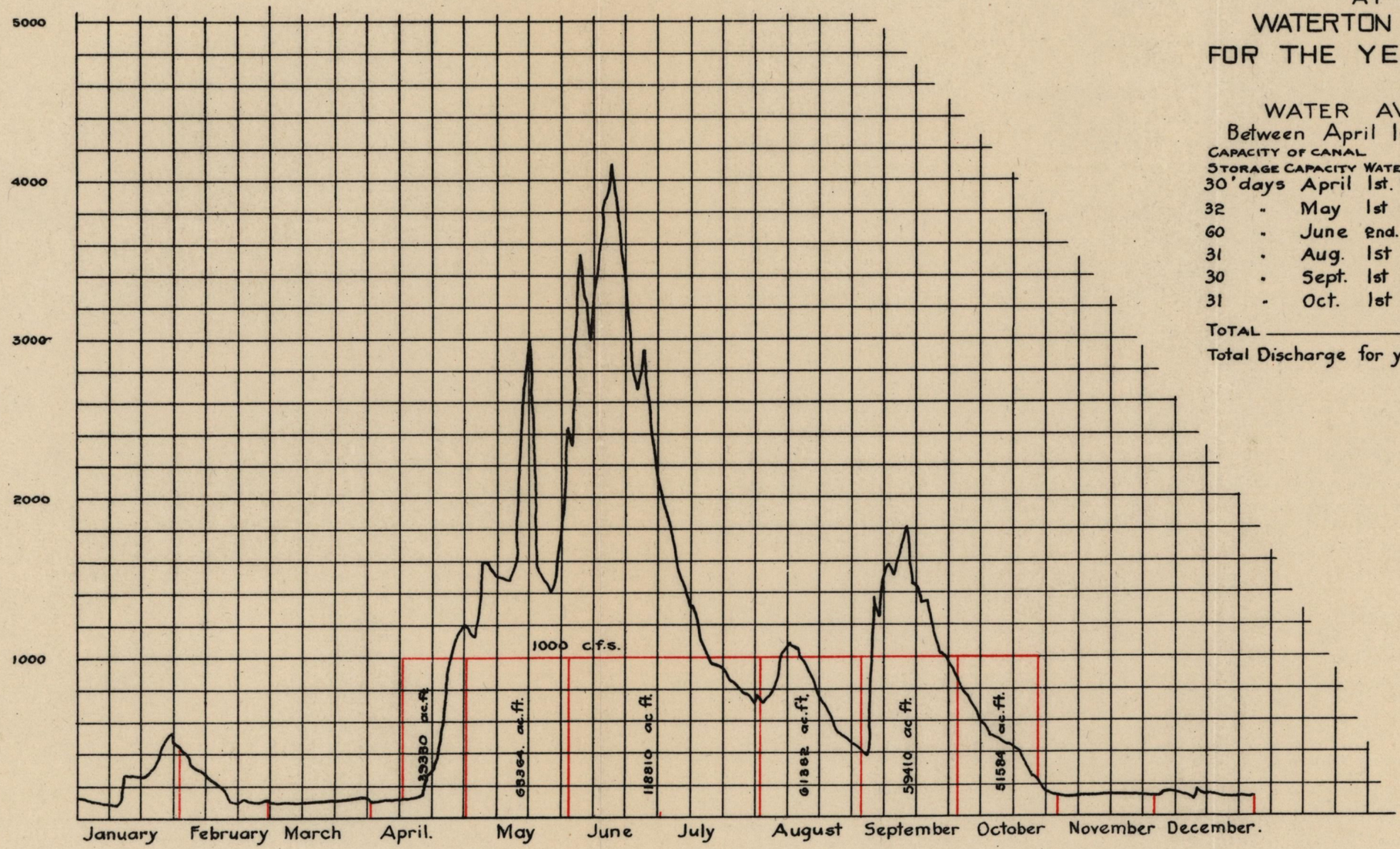


WATER AVAILABLE
Between April 1st and Oct 31st.

CAPACITY OF CANAL				692	C.F.S.
30 days	April	1st	to May 1st.	41100	ac. ft.
32 "	May	1st	to June 2nd	43886	" "
60 "	June	2nd	to Aug 1st	82200	" "
31 "	Aug	1st	to Sept 1st	42478	" "
30 "	Sept	1st	to Oct 1st.	41100	" "
31 "	Oct	1st	to Nov 1st.	38107	" "
TOTAL				288871	" "
Total Discharge for year.				323730	" "

CAPACITY OF CANAL				600	C.F.S.
30 days	April	1st	to May 1st.	35640	ac. ft.
32 "	May	1st	to June 2nd	38061	" "
60 "	June	2nd	to Aug 1st	71280	" "
31 "	Aug	1st	to Sept 1st.	36828	" "
30 "	Sept	1st	to Oct 1st.	35640	" "
31 "	Oct	1st	to Nov 1st.	33197	" "
TOTAL				250646	" "

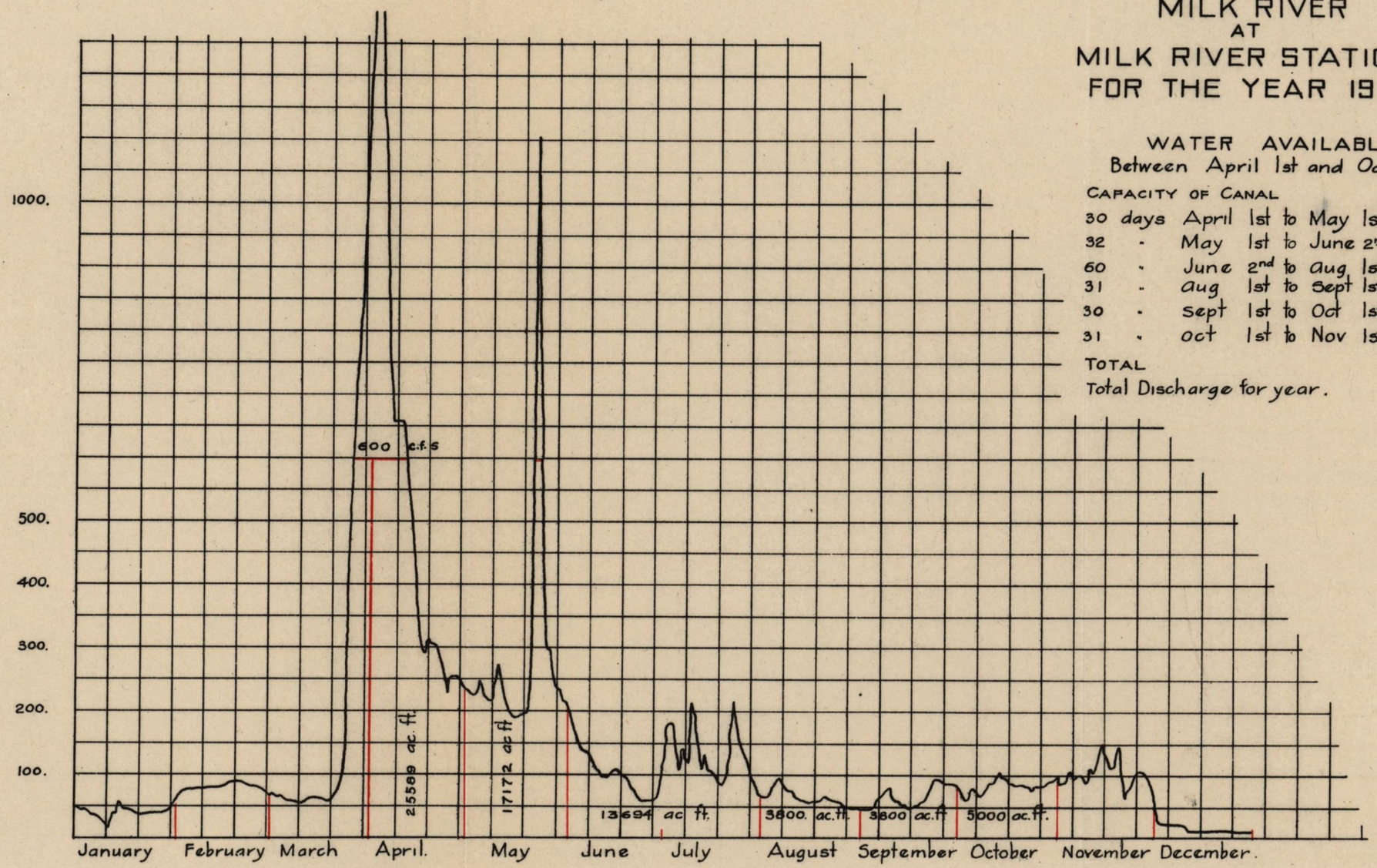
HYDROGRAPH OF THE WATERTON RIVER AT WATERTON MILLS FOR THE YEAR 1911.



WATER AVAILABLE
Between April 1st. and Oct 31st.

CAPACITY OF CANAL				1000	C.F.S.
STORAGE CAPACITY WATERTON LAKES				26,500	Ac. Ft.
30	days	April	1st. to May 1st.	39330	ac. ft.
32	-	May	1st to June 2nd.	63364	" "
60	-	June	2nd. to Aug. 1st.	118,810	" "
31	-	Aug.	1st to Sept. 1st.	61,382	" "
30	-	Sept.	1st to Oct. 1st.	59,410	" "
31	-	Oct.	1st to Nov. 1st.	51.584	" "
TOTAL				393.880	" "
Total Discharge for year				653,400	" "

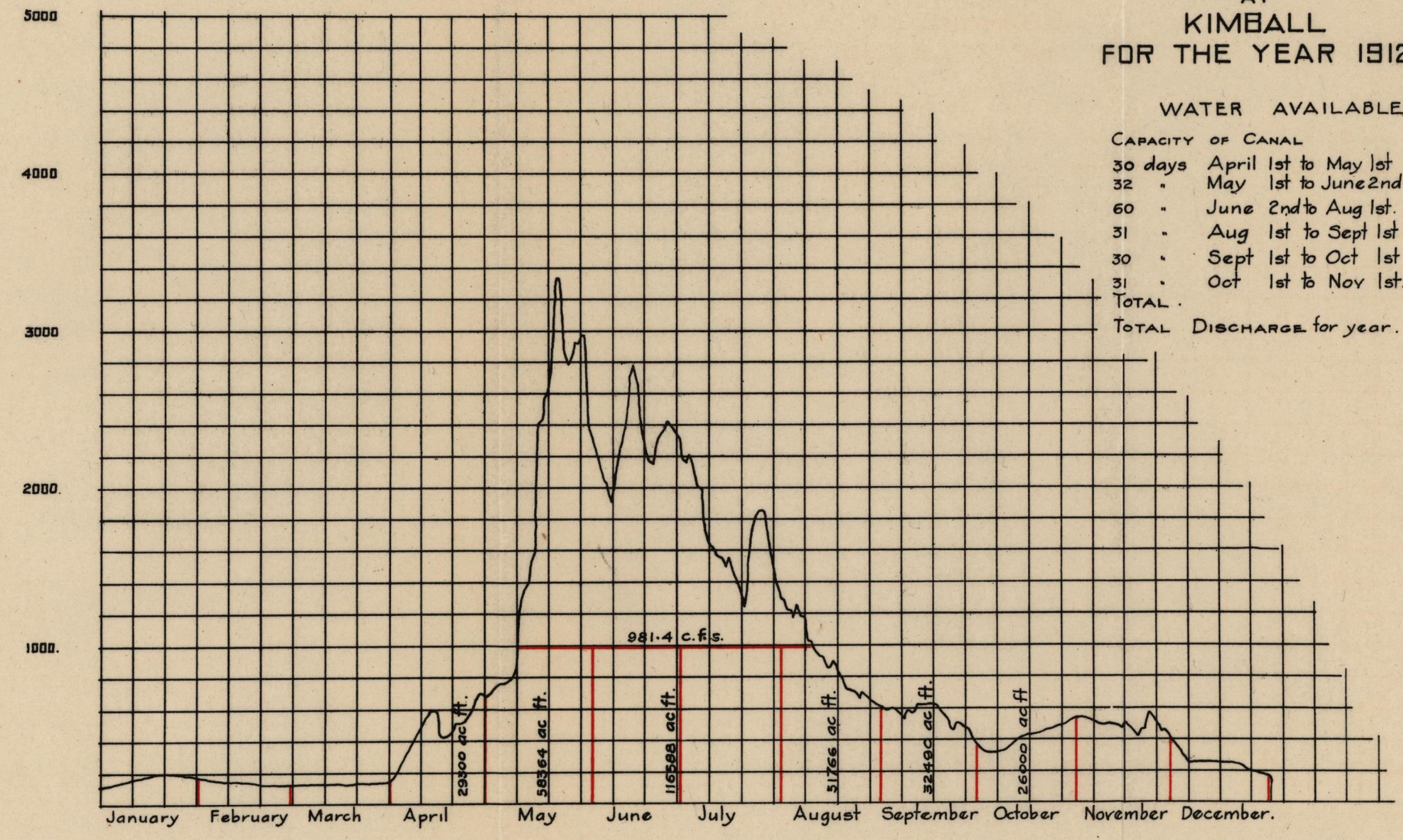
HYDROGRAPH OF MILK RIVER AT MILK RIVER STATION FOR THE YEAR 1912



WATER AVAILABLE
Between April 1st and Oct 31st.

CAPACITY OF CANAL			600	C.F.S.
30 days	April 1st	to May 1st.	25589	ac. ft.
32 "	May 1st	to June 2nd	17172	" "
60 "	June 2nd	to Aug 1st	13694	" "
31 "	Aug 1st	to Sept 1st.	3800	" "
30 "	Sept 1st	to Oct 1st.	3800	" "
31 "	Oct 1st	to Nov 1st.	5000	" "
TOTAL			69055	" "
Total Discharge for year.			158920	" "

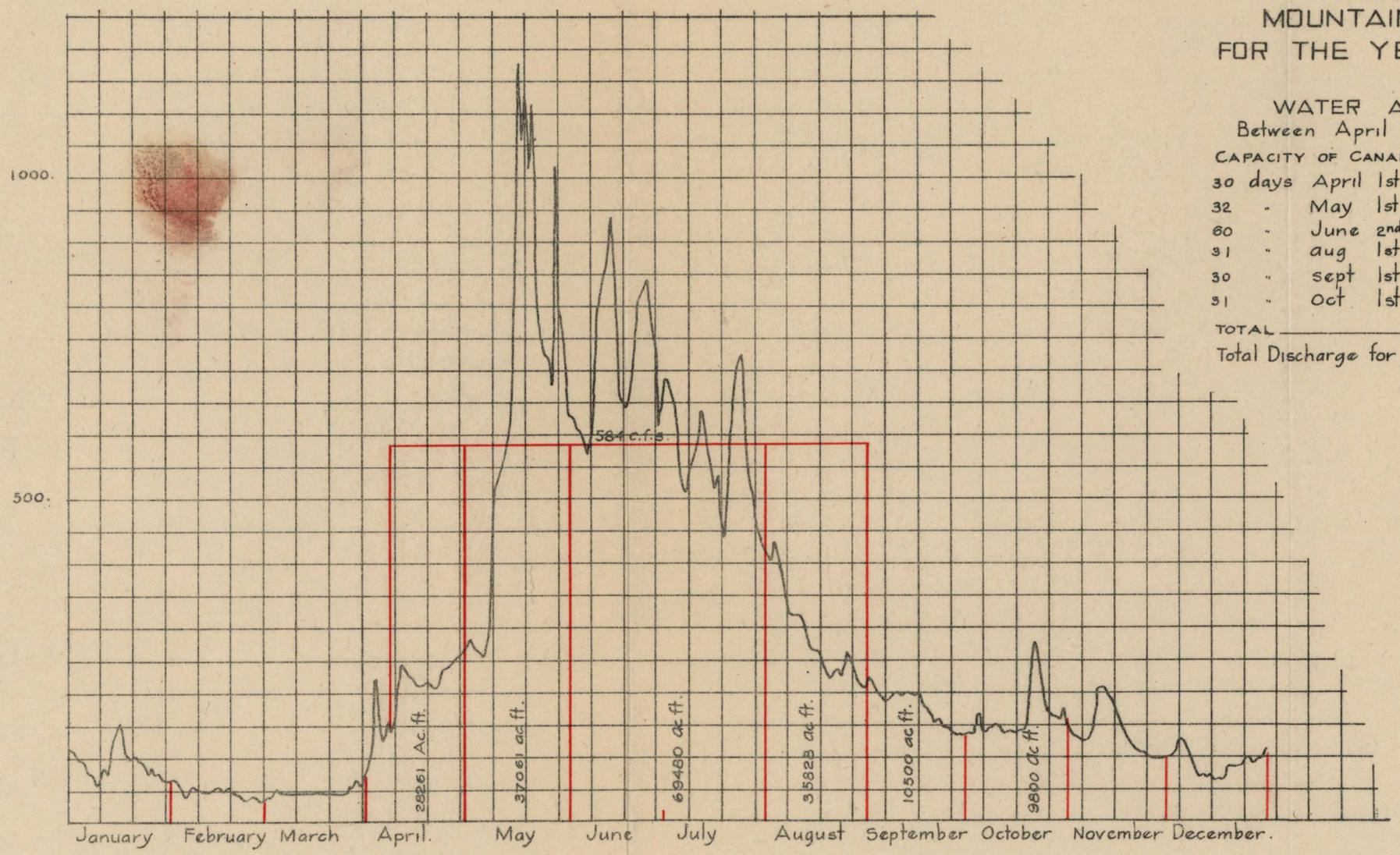
HYDROGRAPH OF STMARY RIVER AT KIMBALL FOR THE YEAR 1912



WATER AVAILABLE.

CAPACITY OF CANAL			981.4 C.F.S
30 days	April 1st to May 1st	29300	ac.ft.
32 "	May 1st to June 2nd	58364	" "
60 "	June 2nd to Aug 1st.	116588	" "
31 "	Aug 1st to Sept 1st	51766	" "
30 "	Sept 1st to Oct 1st	32490	" "
31 "	Oct 1st to Nov 1st.	26000	" "
TOTAL.		314508	" "
TOTAL DISCHARGE for year.		571741	" "

HYDROGRAPH OF THE BELLY RIVER NEAR MOUNTAIN VIEW FOR THE YEAR 1912



WATER AVAILABLE
Between April 1st and Oct 31st.

CAPACITY OF CANAL.			584	C.F.S.
30 days	April 1st	to May 1st	28261	ac.ft.
32 "	May 1st	to June 2nd	37061	" "
60 "	June 2nd	to Aug 1st	69480	" "
31 "	aug 1st	to Sept 1st	35828	" "
30 "	sept 1st	to Oct 1st.	10500	" "
31 "	Oct 1st	to Nov 1st.	9800	" "
TOTAL			190930	" "
Total Discharge for year.			191944	" "

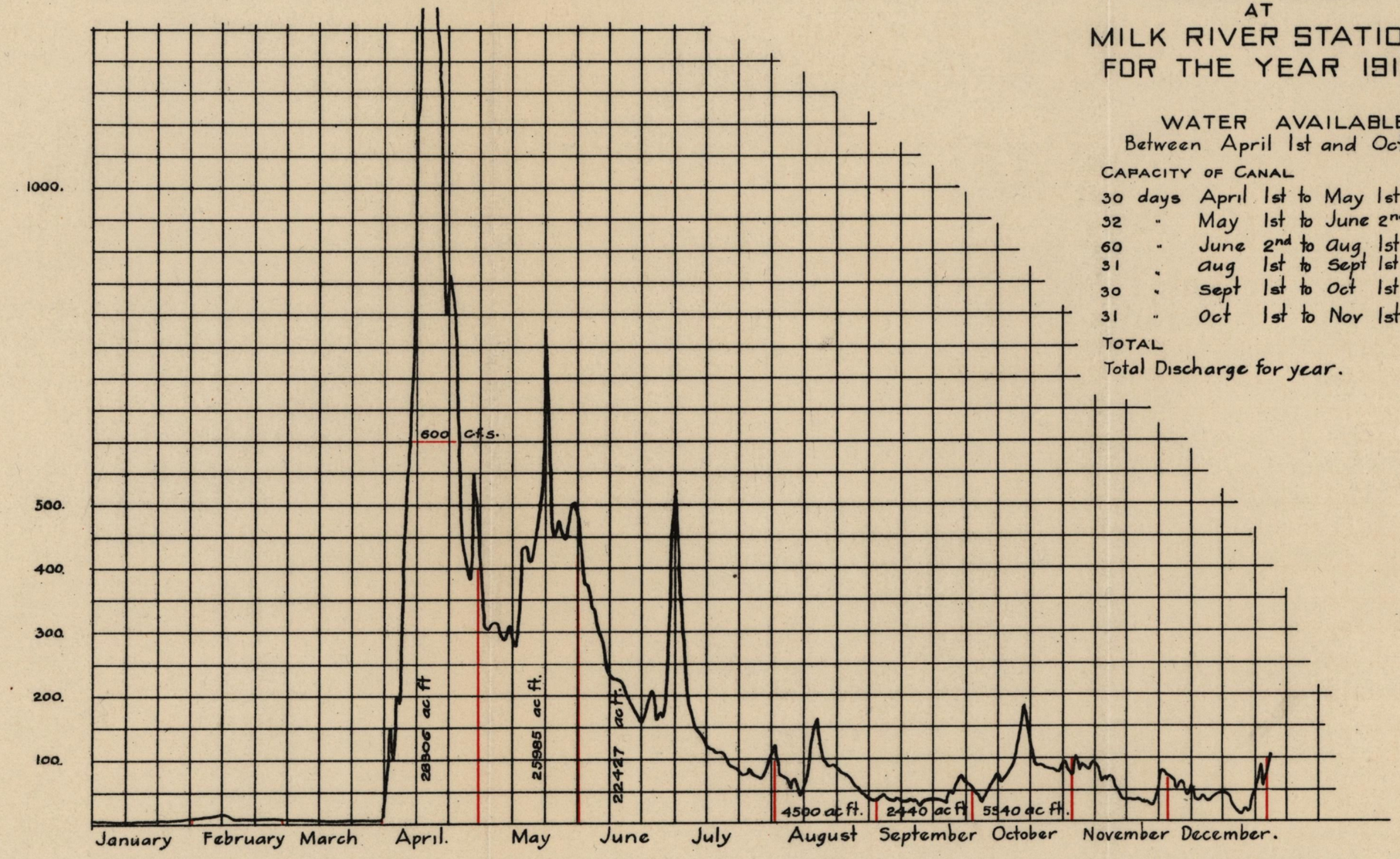
HYDROGRAPH OF THE WATERTON RIVER AT WATERTON MILLS FOR THE YEAR 1912

WATER AVAILABLE
Between April 1st. and Oct. 31st.

CAPACITY OF CANAL					1000	C.F.S.
STORAGE CAPACITY OF WATERTON LAKES					26500	Ac. ft.
30	days	April	1st.	to May 1st.	36960	" "
32	"	May	1st.	to June 2nd	63364	" "
60	"	June	2nd	to Aug. 1st.	118810	" "
31	"	Aug.	1st.	to Sept. 1st.	50989	" "
30	"	Sept.	1st.	to Oct. 1st.	16000	" "
31	"	Oct.	1st.	to Nov. 1st.	20300	" "
TOTAL					306423	" "
Total Discharge for year					424226	

I.C.

HYDROGRAPH OF MILK RIVER AT MILK RIVER STATION FOR THE YEAR 1913



WATER AVAILABLE
Between April 1st and Oct 31st.

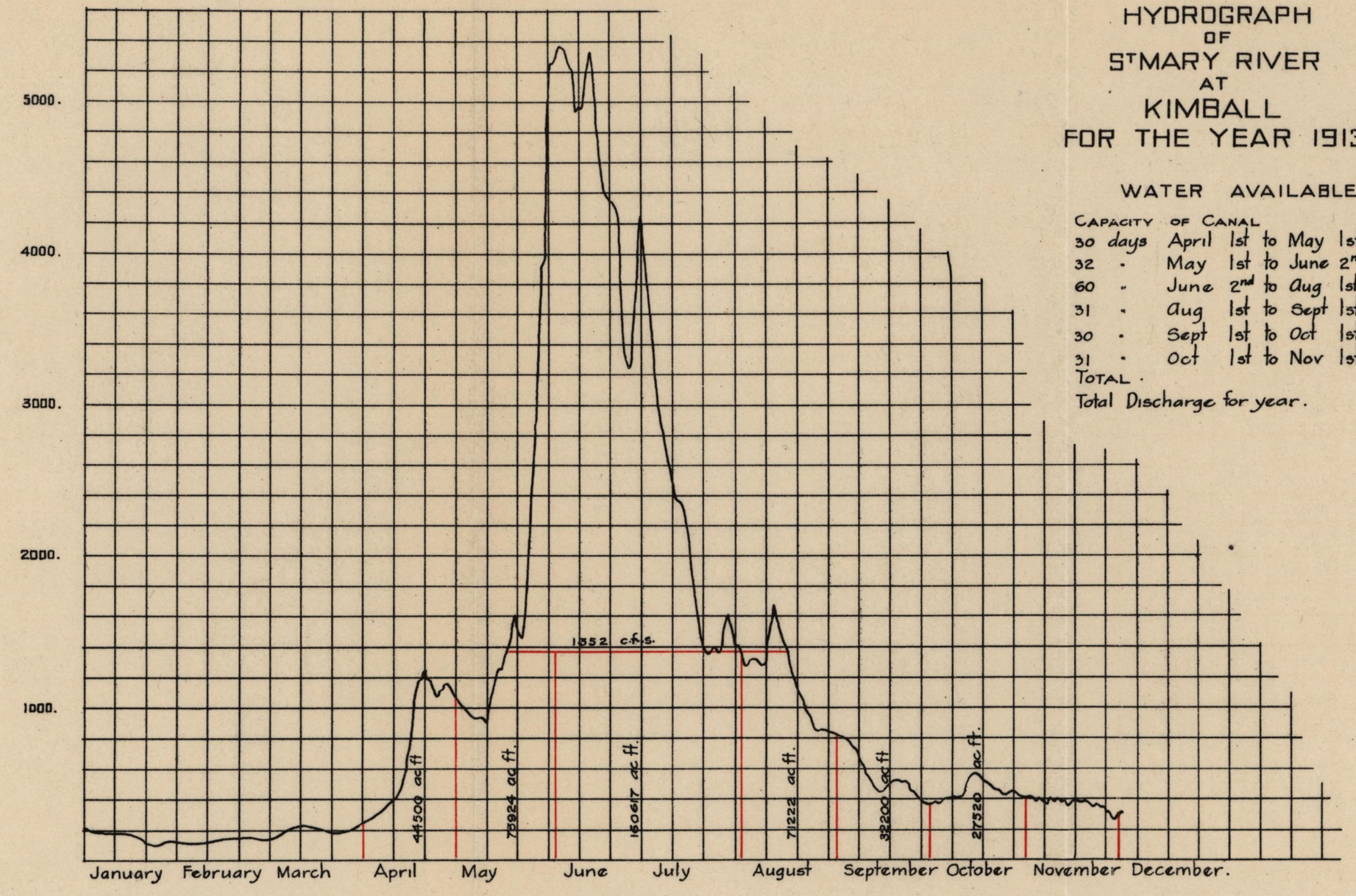
CAPACITY OF CANAL			600	C.F.S.
30 days	April 1st to May 1st		28306	ac. ft.
32 "	May 1st to June 2nd		25985	" "
60 "	June 2nd to Aug 1st		22427	" "
31 "	Aug 1st to Sept 1st		4500	" "
30 "	Sept 1st to Oct 1st		2440	" "
31 "	Oct 1st to Nov 1st		5340	" "
TOTAL			88998	" "
Total Discharge for year.			112333	" "

2.C.

HYDROGRAPH OF St MARY RIVER AT KIMBALL FOR THE YEAR 1913

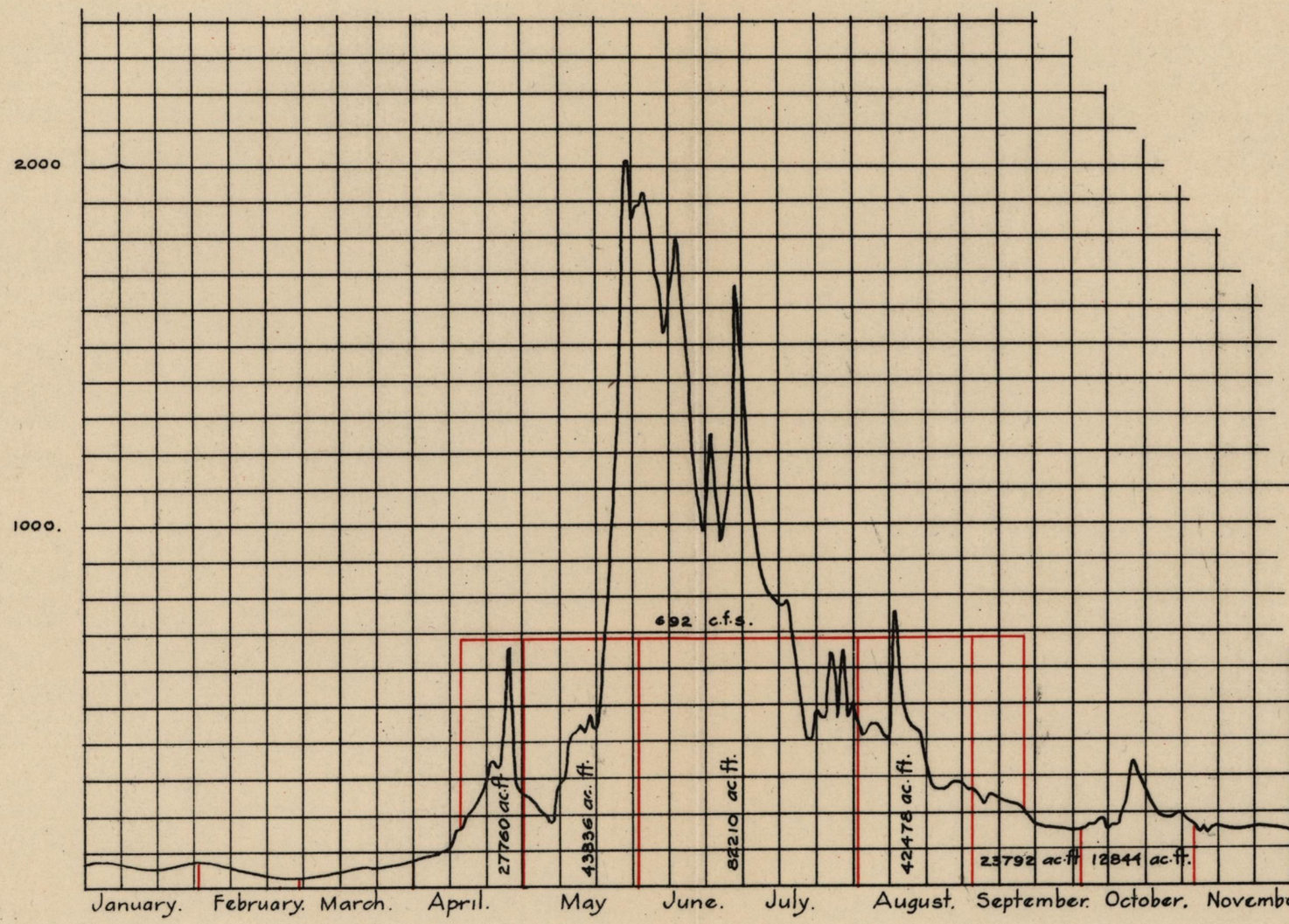
WATER AVAILABLE

Capacity of Canal				1352	C.F.S.
30 days	April 1st	to	May 1st	44500	ac ft.
32 "	May 1st	to	June 2nd	75924	" "
60 "	June 2nd	to	Aug 1st	160617	" "
31 "	Aug 1st	to	Sept 1st	71222	" "
30 "	Sept 1st	to	Oct 1st	32200	" "
31 "	Oct 1st	to	Nov 1st	27520	" "
Total.				411983	" "
Total Discharge for year.				749112	" "



3.C.

HYDROGRAPH OF THE BELLY RIVER NEAR MOUNTAIN VIEW FOR THE YEAR 1913

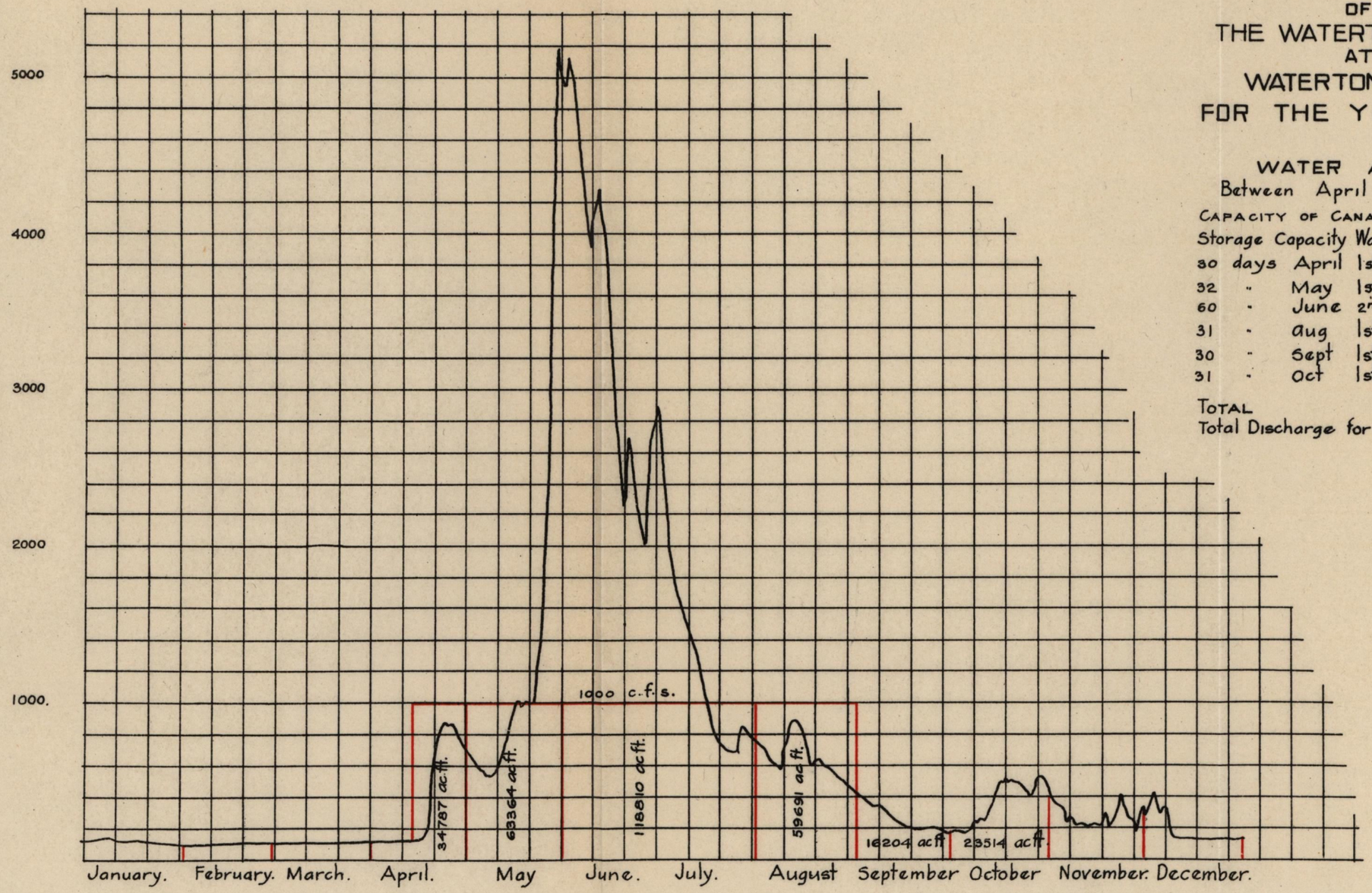


WATER AVAILABLE
Between April 1st and Oct 31st

CAPACITY OF CANAL				692	C.F.S.
30 days	April 1st	to	May 1st.	27760	ac.ft.
32 "	May 1st	to	June 2nd	43836	" "
60 "	June 2nd	to	Aug 1st	82210	" "
31 "	Aug 1st	to	Sept 1st	42478	" "
30 "	Sept 1st	to	Oct 1st.	23792	" "
31 "	Oct 1st	to	Nov 1st.	12844	" "
TOTAL				232920	" "
Total Discharge for year				252545	" "

CAPACITY OF CANAL				600	C.F.S.
30 days	April 1st	to	May 1st.	24305	ac.ft.
32 "	May 1st	to	June 2nd	38016	" "
60 "	June 2nd	to	Aug 1st	71280	" "
31 "	Aug 1st	to	Sept 1st	36828	" "
30 "	Sept 1st	to	Oct 1st	21242	" "
31 "	Oct 1st	to	Nov 1st.	12844	" "
TOTAL				204515	" "

HYDROGRAPH OF THE WATERTON RIVER AT WATERTON MILLS FOR THE YEAR 1913



WATER AVAILABLE
Between April 1st and Oct 31st

CAPACITY OF CANAL				1000 C.F.S.
Storage Capacity Waterton Lake.				26500 ac.ft.
30 days	April 1st	to	May 1st.	34787 " "
32 "	May 1st	to	June 2nd	63364 " "
60 "	June 2nd	to	Aug 1st	118810 " "
31 "	Aug 1st	to	Sept 1st	59691 " "
30 "	Sept 1st	to	Oct 1st.	16204 " "
31 "	Oct 1st	to	Nov 1st.	23514 " "
TOTAL				316370 " "
Total Discharge for year				516419 " "

average high and average low years. It is believed that a study of the flow for these three years will give better results than if extreme years were dealt with, for the following reason:—The interval between an extreme high year and an extreme low one is so great that if provision were made to store the flood waters of the high year, and hold them over to be utilized during a year of extreme low flow, even if it were practicable to do so, the amount of water lost through absorption would render the advantage gained doubtful.

The result of the studies of stream flow during these three years will at least show in a general manner how such a project would have to be operated.

RESERVOIR SITES.

In addition to the reservoir sites directly tributary to the irrigable areas further storage sites at the heads of the Waterton and Belly rivers are necessary in order to divert the quantities of water required from these streams.

Waterton River Sites.—No surveys with regard to storage possibilities have as yet been made of the Waterton lakes, but there is no doubt that a considerable quantity of water can be stored in at least one of these lakes very cheaply. It is estimated that by constructing a dam with an effective height of seven and one-half feet at the lower end of the Upper Waterton lake, it would be possible to impound 26,400 acre-feet of water, and in estimating the available water supply from the Waterton river it is assumed that this quantity of water will be stored.

Belly River Sites.—A reconnaissance of the lakes at the headwaters of the Belly river was made last season and it is believed that four of these lakes will be feasible as storage sites. It is estimated that in these lakes, in addition to some smaller sites lower down the river, it will be feasible to store some 34,600 acre-feet of water, and in calculating the available supply from the Belly river it is assumed that this quantity of water will be stored.

STUDY OF CURVES.

The hydrographs accompanying this report are plotted from records kept of the Milk, St. Mary, Belly, and Waterton rivers by this department. The stations considered are very close to the proposed intakes of canals so that the quantities of water shown available from these curves should be very nearly correct.

There are of course innumerable ways in which the required amount of water can be run off from these streams and it will only be after a more thorough investigation of the available storage sites, canal routes, etc., that the most feasible method can be determined. It is considered here that the canal capacities, and reservoir capacities adopted, will be the most economical ones, but there is not sufficient data at hand to state positively that such is the case.

It is believed that a canal of 1,000 c.f.s. capacity is as large a canal as it will be found feasible to construct from the Waterton to the Belly river. It may be found, however, when this route is actually surveyed, that a canal of larger or smaller capacity than this will be more feasible. If a larger canal were adopted it would be possible with the same storage capacity considered here, viz., 26,400 acre-feet, to utilize more water from this river than estimated here, or it would be possible to utilize the same quantity with a storage site of less capacity than 26,400 acre-feet.

From the Belly river during the years 1911 and 1913 with a storage capacity of 34,600 acre-feet it is possible to run off a continuous discharge of 692 c.f.s. through-

out the greater portion of the open water season, which is considered here to be from April 1 to October 31. During the year, however, it would only have been possible to run off 584 c.f.s. continuously between April 7 and August 31, and to run the natural flow of the river during the remainder of the season.

It will be seen that during this year the total discharge of the river was 191,944 acre-feet and that it is possible to utilize 190,930 acre-feet. There is not, however, sufficient run-off during the months of January, February, and March to fill a reservoir of 36,400 acre-feet capacity, but it is considered that this deficiency would be made up from the discharge of the river during November and December of the previous year.

On the Milk and St. Mary rivers it may not be feasible to create storage reservoirs in which to impound and thus utilize the winter discharge, and since it is not practicable to operate canals during the entire winter the only quantity of water considered as available from these streams is the portion of the run-off between April 1 and October 31, which it will be feasible to divert.

It should be emphasized here, however, that there is an opportunity to store a considerable amount of St. Mary river water by damming the St. Mary river in sections 4 and 9, township 1, range 25, west 4th meridian by constructing a dam 105 feet in height that would impound some 37,000 acre feet of water. It is quite possible, however, that more water than this could be stored at this location. In the event of the United States being unwilling to store and include in their share of the St. Mary river water, the winter flow and high floods of this stream, it will be necessary in order to utilize these waters in Canada, to build this dam since this is the only available storage site on the St. Mary river in this country.

The construction of this dam would also make it feasible to divert water into the St. Mary lakes and Taylorville reservoirs and the total of the three storages would be about 100,000 acre feet or equal to the normal winter flow of the St. Mary river.

DISCUSSION OF TABLES.

For convenience in studying the stream flow and canal system, to determine the most economical method of handling the water it was found necessary to deal with lands directly tributary to the Milk and St. Mary rivers more or less separately, and the portion of the system directly tributary to the Milk river has been called the Milk river system and that directly tributary to the St. Mary river, the St. Mary river system.

The St. Mary river system includes all of the irrigable areas in tracts 1, 2, 3, 4, 5, and 7A while the Milk river system includes the irrigable areas in tracts 6, 7B, 7C and 8. It will be readily seen that the former tracts are more directly tributary to Lumpy Butte, Milk river, Raymond, and Chin Lake reservoirs, while the latter are directly tributary to Brunton and Verdigris reservoirs. The former reservoirs have been called the St. Mary river system of reservoirs while the latter have been called the Milk river system of reservoirs.

After water from the St. Mary river system has been dropped down to the Branton and Verdigris reservoirs, it can only be utilized on tracts 6, 7B, and 7C.

It is possible to build a canal from Milk river to the Milk river reservoir, thus utilizing Milk river water to irrigate tracts in the St. Mary river system, but although this is necessary in the second system of canals, which will be described later, it is not necessary in the first system, since any surplus water there is comes from the St. Mary river system and no Milk river water is required on the lands directly tributary to the St. Mary river.

It will be seen from tables 2 to 5, as well as from the sketch maps accompanying this report that two systems of canals have been designed.

The first system is designed to carry sufficient water from the rivers to irrigate the irrigable areas in all of the tracts with the exception of tract 1C of 3,840 acres; in other words the first system would irrigate in all 548,456 acres.

The second system of canals has been designed only to carry sufficient water to irrigate what are considered to be the most suitable tracts for irrigation.

In the first system it is anticipated that the Waterton river will be diverted, while in the second system it is considered that only a maximum quantity of 600 c.f.s. from the Belly river is required in addition to the available quantities from the Milk and St. Mary rivers.

First system of canals.—In order to irrigate all of the 548,456 acres of land under this system it will be seen that in addition to the fifty-five per cent of the St. Mary river water which would be diverted at Kimball, an amount of water about 46,645 acre-feet (net at Milk river headgate) is assumed to be carried through the United States canal to Milk river; or it amounts to Canada getting, instead of fifty-five per cent of the St. Mary river water, something like sixty-two per cent of this water, an amount of ten per cent having been allowed for losses in transmission between the St. Mary lakes and the headgates at Milk river station, where this water together with the Milk river water is diverted.

These 46,645 acre-feet correspond to an area of 23,323 acres which is just 3,323 acres greater than the irrigable area estimated in tract 8. In the description of irrigable areas, it was pointed out that in all probability this tract would not require to be irrigated, so that in the event of cutting out this tract it would not be necessary to divert any water through the United States canal, but simply increase the canals from the Waterton and Belly rivers to sufficient capacity to provide water for this 3,323 acres.

The discharges for the different periods throughout the open water season have been tabulated from August to July. During June and July the maximum quantity of water for irrigation is required on the land, a net duty of twelve inches being considered necessary during this period. During August, September, and May only two inches net per month are required so that a considerable quantity of water run from the rivers during these months must be stored.

It is obvious that a sufficient quantity of water must be stored during the months of August, September, October, April and May, during which period very little water is required for irrigation, to provide for the months of June and July when the maximum quantity of water is required.

It will be evident that the water stored during the months of August, September, and October for the year 1911, for instance, is not available for use during June and July of that same year, as the tables indicate, but would only be available for use during the following year. The tables as made out assume that two year identically the same follow one another. Such a condition would probably never occur but the results of a study of the water supply upon this assumption will be sufficiently close for present purposes.

Considering the year 1913, the total quantity of water available from the Waterton, Belly and St. Mary rivers during the month of August is 173,391 acre-feet (gross) (see table 2), while the quantity required on the lands tributary to the St. Mary river during this period is 89,689 acre-feet (gross). There is, therefore, a surplus of 72,821 acre-feet (net at reservoirs) from the Waterton, Belly, and St. Mary rivers during the month of August. From the Milk river (see table 3), during August, there is, with the addition of 5,184 acre-feet carried from the St. Mary lakes through the United States canal, a gross quantity of 9,684 acre-feet available, while the quantity required on the lands tributary to the Milk river is 32,189 acre-feet (gross), leaving a deficiency (net at the reservoirs) of 19,579 acre-feet. This deficiency is provided

for from the 72,821 acre-feet surplus water from the St. Mary river system, by diverting 19,579 acre-feet through the Brunton and Verdigris reservoirs. The remaining 53,242 acre-feet is stored in the St. Mary river system of reservoirs. During the month of September there is a deficiency of water from all of the rivers so that the reservoirs have to be drawn upon during that month.

During October there is a surplus (net at reservoirs) of 55,574 acre-feet from the Waterton, Belly, and St. Mary rivers, and a surplus of 4,646 acre-feet (net at reservoirs) from the Milk river, which quantities are stored in their respective reservoir systems. During April there is a quantity of 93,131 acre-feet (net at reservoirs) available from the Waterton, Belly and St. Mary rivers while from the Milk river there is 24,626 acre-feet which is stored. During May there is a surplus (net at reservoirs) of 81,289 acre-feet from the Waterton, Belly and St. Mary rivers, while from the Milk river there is a deficiency of 887 acre-feet (net at reservoirs). Therefore at the end of May there is stored in the St. Mary river reservoir system 153,556 acre-feet and in the Milk river system of reservoirs 121,474 acre-feet.

During June and July the quantity of water available from the Waterton, Belly, and St. Mary rivers is 361,637 acre-feet (gross) and the quantity required to irrigate the lands tributary to the St. Mary river is 538,138 acre-feet (gross) leaving a deficiency (net at reservoirs) of 153,566 acre-feet. From the Milk river during June and July there is available 53,520 acre-feet (gross) while the quantity of water required during that period on lands tributary to Milk river is 193,141 acre-feet (gross) leaving a deficiency (net at the reservoirs) of 121,470 acre-feet.

The quantity of water deficient, from the rivers during June and July, is therefore covered by storage.

During the year 1912 the deficiency during June and July is 202,936 acre-feet, and this should be the combined capacity of the St. Mary river system of reservoirs. During the year 1911 the quantity of water which it is necessary to store in the Milk river system of reservoirs was 206,217 acre-feet, and this should be the maximum capacity of the Milk river system of reservoirs.

It will be seen from these tables that all of the main canals could be designed, and although this has been done it is not possible to discuss this portion of the work in this report.

Second system of canals.—As was pointed out previously, the second system of canals designed only provides water for what have been considered the most suitable tracts to irrigate. The distribution of the water to the reservoirs and then to the land should be readily followed from tables 4 and 5.

In this system it is evident that at certain periods it is required to carry water from the Milk river to the lands tributary to the St. Mary river. This is not necessary in the first system, but as was pointed out it can easily be done by constructing the canal from Milk river to the Milk river reservoir, thus allowing the water to be utilized either on lands tributary to the St. Mary river or tributary to the Milk river.

CONCLUSION.

In concluding this report it should be said that in connection with these Milk and St. Mary rivers surveys a considerable amount of cost data has been worked up, but owing to lack of surveys it is not possible as yet to put this information in any complete form whereby anything more than an approximate estimate of the cost of any project to irrigate the lands under consideration can be arrived at. A great many more surveys will be necessary before the question of cost can be intelligently considered.

It has already been stated that a safe duty of water for the lands under consideration has been taken as eighteen inches net, and that in estimating the amount of water required for the irrigable areas an irrigation factor of eighty per cent has been assumed.

From the sources of supply under consideration the water supply is very critical and the question of duty of water is a most important one. It has been estimated, for instance, that the quantity of water required to irrigate 548,456 acres is 1,096,916 acre-feet. If the legal requirements were complied with, however, the quantity of water required to irrigate this area would be 1,826,358 acre-feet, a difference of 729,442 acre-feet. If then a net duty of two acre-feet per acre was required on the land only a small portion of the irrigable area could be watered from the sources under consideration.

TABLE 2.

A.

First System of Canals showing Water Available in Acre-Feet. Area Tracts St. Mary River System, 403,602 Acres.

Net duty of water 18 inches per acre. Irrigation factor 0·8.

Year 1911.	Waterton	Belly.	St. Mary.	Total.	Duty, Gross.	Surplus Gross.	Surplus Net at Reservoir.	From Source of Supply.	
								Deficiency Gross.	Deficiency Net at Reservoir.
August	61,382	42,478	61,374	165,234	89,689	75,545	65,724		
September	59,410	41,100	66,044	166,554	89,689	76,865	66,873		
October	51,584	38,107	41,500	131,191		131,191	114,136		
April	39,330	41,100	31,236	111,666		111,666	97,149		
May	63,364	43,886	72,059	179,309	89,689	89,620	77,969		
June and July	118,810	82,200	135,000	336,010	538,138			202,128	175,851
Total	393,880	288,871	407,213	1,089,964	807,205	484,887	421,851	202,128	175,851

Storage water carried over to year 1912=27,085 acre-feet.

B.

1912									
August	50,989	35,828	51,766	138,583	89,689	48,894	42,538		
September	16,000	10,500	32,490	58,990	89,689			30,699	26,708
October	20,300	9,800	26,000	56,100		56,100	48,807		
April	36,960	28,261	29,300	94,521		94,521	82,233		
May	63,364	37,061	58,364	158,789	89,689	69,100	60,117		
June and July	118,810	69,480	116,588	304,878	538,138			233,260	* 202,936
Total	306,423	190,930	314,508	811,861	807,205	268,615	233,695	263,959	229,644

Amount of water deficient=17,795 acre-feet.
* Maximum capacity required St. Mary river storage.

C.

1913.									
August	59,691	42,478	71,222	173,391	89,689	83,702	72,821		
September	16,204	23,792	32,200	72,196	89,689			17,493	15,219
October	23,514	12,844	27,520	63,878		63,878	55,574		
April	34,787	27,760	44,500	107,047		107,047	93,131		
May	63,364	43,836	75,924	183,124	89,689	93,435	81,289		
June and July	118,810	82,210	160,617	361,637	538,138			176,501	153,556
Total	316,370	232,920	411,983	961,273	807,205	348,062	302,815	193,994	168,775

NOTE.—Study this table with table 3.

TABLE 3.

A.

First System of Canals, showing Water Available in Acre-Feet. Area Tracts Milk River System, 144,854 Acres.

Net duty of water 18 inches per acre. Irrigation factor 0·8.

Year 1911.	Milk.	Required from St. Mary River through U. S. Canal, Net at Milk River Intake.	Total.	Duty (Gross).	Surplus (Gross).	Surplus Net at Reservoir.	From Source of Supply.		Surplus from St. Mary River System.	Stored in St. Mary River System.	Stored in Milk River System.
							Deficiency Gross.	Deficiency Net at Reservoir.			
August	5,680	5,184	10,864	32,189			21,325	18,553	65,724	47,171	
September	15,000	5,184	20,184	32,189			12,005	10,444	66,873	103,600	
October	7,300		7,300		7,300	6,351			114,136	202,936	21,151
April	18,290		18,290		18,290	15,912			97,149		134,212
May	20,150	5,184	25,334	32,189			6,855	5,964	77,969		206,217*
June and July	22,575	31,093	53,668	193,141			139,473	121,342	-175,851	-175,851	-121,342
Total	88,995	46,645	135,640	289,708	25,590	22,263	179,658	156,303		27,085	84,875

* Maximum capacity required Milk river storage.

Storage water carried over to year 1912=84,875 acre-feet.

B.

1912.											
							Carried over from year 1911.			27,085	84,875
August	3,800	5,184	8,984	32,189			23,205	20,188	42,538	49,435	
September	3,800	5,184	8,984	32,189			23,205	20,188	-26,708	2,539	
October	5 000		5,000		5,000	4,350			48,807	51,346	89,225
April	25,589		25,589		25,589	22,262			82,233	133,579	111,487
May	17,172	5,184	22,356	32,189			9,833	8,555	60,117	185,141	
June and July	13,694	31,093	44,787	193,141			148,354	129,068	-202,936	-202,936	-129,068
Total	69,055	46,645	115,700	289,708	30,589	26,612	204,597	177,999		-17,795	-17,581

Amount of water deficient=17,581 acre-feet.

1913.											
August	4,500	5,184	9,684	32,189			22,505	19,579	72,821	53,242	
September	2,440	5,184	7,624	32,189			24,565	21,372	−15,219	16,651	
October	5,340		5,340		5,340	4,646			55,574	72,225	4,646
April	28,306		28,306		28,306	24,626			93,131	153,556	41,072
May	25,985	5,184	31,169	32,189			1,020	887	81,289		121,474
June and July	22,427	31,093	53,520	195,141			139,621	121,470	−153,556		
Total	88,998	46,645	135,643	289,708	33,646	29,272	187,711	163,308			

NOTE.—Study this table with table 2.

TABLE 4.

A

Second System of Canals, Showing Water Available in Acre-Feet. Area Tracts St. Mary River System, 319,602 Acres.

Net duty of water 18 inches per acre. Irrigation factor 0·8.

Year 1911.	Belly.	St. Mary.	Total.	Duty Gross.	Surplus Gross.	Surplus Net at Reservoir.	At Source of Supply.	
							Deficiency Gross.	Deficiency Net at Reservoir.
August	36,828	61,374	98,202	71,022	27,180	23,647		
September	35,640	66,044	101,684	71,022	30,662	26,676		
October	33,197	41,500	74,697		74,697	64,986		
April	35,640	31,236	66,876		66,876	58,182		
May	38,061	72,059	110,120	71,022	39,098	34,015		
June and July	71,280	135,000	206,280	426,138			219,858	191,277
Total	250,646	407,213	657,859	639,204	238,513	207,506	219,858	191,277

Storage water carried over to year 1912=28,254 acre-feet.

B.

1912.								
August	35,828	51,766	87,594	71,022	16,572	14,418		
September	10,506	32,490	42,990	71,022			28,032	24,388
October	9,800	26,000	35,800		35,800	31,146		
April	28,261	29,300	57,561		57,561	50,078		
May	37,061	58,364	95,425	71,022	24,403	21,231		
June and July	69,480	116,588	186,068	426,138			240,070	208,861
Total	190,930	314,508	505,438	639,204	134,336	116,873	268,102	233,249

1913.								
August	36,828	71,222	108,050	71,022	37,028	32,214		
September	21,242	32,200	53,442	71,022			17,580	15,295
October	12,844	27,520	40,364		40,364	35,117		
April	24,305	44,500	68,805		68,805	59,860		
May	38,016	75,924	113,940	71,022	42,918	37,339		
June and July	71,280	160,617	231,897	426,138			194,241	168,990
Total	204,515	411,983	616,498	639,204	189,115	164,530	211,821	184,285

NOTE.—Study this table with table 5.

TABLE 5.

A.

Second System of Canals, Showing Water Available in Acre-Feet. Area Tracts Milk River System 33146 Acres.

Net duty of water 18 inches per acre. Irrigation factor 0·8.

Year 1911.	Milk River.	Duty Gross.	Surplus Gross.	Surplus Net at Reservoir.	From Source of Supply.		Available from St. Mary River System.	Stored in St. Mary River Reservoir System.	Stored in Milk River Reservoir System.
					Deficiency Gross.	Deficiency Net at Reservoir.			
August	5,680	7,635			1,685	1,466	23,647	22,181	
September	15,000	7,365	7,365	6,642			26,676	48,857	6,642
October	7,300		7,300	6,351			64,985	113,842	12,993
April	18,290		18,290	15,912			58,182	174,393	26,535
May	20,150	7,365	12,785	11,123			34,015	219,531	
June and July	22,575	44,195			21,620	18,809	−191,277	−191,277	−18,809
Total	88,995	66,292	46,010	40,028	23,305	20,275		28,254	7,726

Storage water carried over to year 1912 = 7,726 acre-feet.

B.

1912.									
August	3,800	7,635			3,565	3,102	14,418	28,254	7,726
September	3,800	7,365			3,565	3,102	−24,388	39,570	
October	5,000		5,000	4,350			31,146	12,080	
April	25,589		25,589	22,263			50,078	43,226	12,076
May	17,172	7,365	9,807	8,532			21,231	101,107	26,536
June and July	13,694	44,195			30,501	26,536	−208,861	130,870	
Total	69,055	66,292	40,396	35,145	37,631	32,740		−208,861	−26,536
								−77,991	

Amount of water deficient 77,991 acre-feet.

1913.									
August	4,500	7,365	.....	.....	2,865	2,493	32,214	29,721	
September	2,440	7,365	.....	.....	4,925	4,285	–15,295	10,141	
October	5,340	.....	5,340	4,646	.....	.....	35,117	45,258	4,646
April	28,306	.....	28,306	24,626	.....	.....	59,860	115,452	18,938
May	25,985	7,365	18,620	16,199	.....	.....	37,339	168,990	
June and July	22,427	44,195	.....	.....	21,768	18,938	–168,990	–168,990	–18,938
Total	88,998	66,292	52,266	45,471	29,558	25,716			

NOTE:—Study this table with table 4.

SUMMARY OF FIELD WORK COMPLETED DURING 1914 ON THE MILK AND ST. MARY RIVERS SURVEYS.

(Prepared by F. H. Peters, Commissioner of Irrigation.)

Three field parties were employed on this work during the season, and the area developed by the network of the levelling is referred to later. The canals which were located are shown on the plan submitted with this report entitled, "Map of area developed by Milk and St. Mary Rivers Surveys."

The general requirement of the surveys was to develop fully the great area of irrigable land, lying between the Belly river and the Milk river and extending from the St. Mary river on the west to Forty Mile coulee and Pakowki lake on the east, and also to develop fully the possibilities of diverting and storing the water from the St. Mary and Milk rivers to serve the irrigable land developed.

Party number (9) under the charge of Mr. T. M. Montague, with Mr. L. J. Gleeson as assistant, was employed in locating canals and reservoirs to develop the possibilities of diverting and conserving irrigation water from the St. Mary river and the Milk river to water an additional tract of about 381,000 acres of irrigable land to the east of the present Alberta Railway and Irrigation Company's project and between the Crowsnest branch of the Canadian Pacific Railway and the Milk river. This party took the field on the 12th May, and disbanded on October 12, completing a working season of 131 days. During the field season the party ran 302 miles of complete traverse and level lines, surveyed 3 reservoir sites, including 300 miles of contour survey, developed one complete dam site and set twelve permanent iron bench-marks. During the winter months a complete report with plotted plans was prepared. The party consisted of thirteen men with nine horses.

Party number (10) under the charge of Mr. N. M. Sutherland, with Mr. W. Jackson as assistant, was employed projecting a system of levels along all the township lines in the district indicated under party number (9) in order to develop the irrigable areas that could be commanded. About half the area to be studied was assigned to this party and when the levelling operations had been completed the party extended the work being done by party number (9) by picking up their work and projecting the main irrigating canals through the irrigable land. This party took the field on May 9, and continued at this work until September 26, when it was transferred to other work. A working period of 120 days was put in on this work during which time the party ran 644 miles of level lines, setting thirty-five permanent iron bench-marks and in addition ran 138·7 miles of complete traverse and level lines.

Party number (11) under the charge of Mr. A. W. P. Lowrie, with Mr. H. D. St. A. Smith as assistant, was employed on similar work to party number (10) on the Milk and St. Mary rivers project developing the remaining one-half of the irrigable area. This party took the field on May 11, and disbanded on September 26, completing a working season of 121 days. During the season the party ran 615 miles of level lines, set forty-five permanent iron bench-marks and ran seventy-two miles of complete traverse and level lines on canal location. During the winter months a complete report with plotted plans was prepared. The party consisted of eleven men with six horses.

In order to summarize the general information gained by the three field parties the following schedules are inserted:—

SCHEDULE of Reservoir Sites investigated in part or in full during 1914, with approximate costs.

Name.	Location. Tp.	Rge.	Mer.	Flooded area in acres.	Capacity in acre-feet.	Cost per acre foot.	Remarks.
						$ cts.	
Mary Lakes	1	24-25	4	975	20,000	5 94	
Taylorville	1	24	4	3,722	42,836	3 62	
St. Mary river	1	25	4	.....	37,000		
Lumpy Butte	3	24	4	1,151	12,473	6 41	
Chin Lake	8	18	4	.....	80,000	0 68	Used by A. R. & I. Co. additional development.
Shanks Lake	1	20-21	4	4,455	95,958	3 20	
Verdigris Lake	3 & 4	15-16	4	2,700	100,000	2 66	
Milk river	5	19-20	4	2,123	47,364	2 74	
Raymond	5	20-21	4	782	13,346	13 05	
Brunton	4 & 5	17-18	4	.....	67,000	3 00	

SCHEDULE of Irrigable Areas investigated during 1914, with approximate cost per acre of Irrigation works complete.

Tract.	Irrigable area.	Cost of structures.	Cost of canals.	Lateral system.	Total cost.	Cost per acre.	Remarks.
	Acres.	$	$	$	$	$ cts.	
5A.	123,000	101,840	658,400	615,000	1,375,240 10% 1,512,764	22 30	
5B.	84,000	196,000	728,800	420,000	1,344,800 10% 1,479,280	27 61	
6	63,000	151,294	760,262	315,000	1,226,556 10% 1,349,211	31 43	
7C.	26,622	60,000	326,750	133,110	519,860 10% 571,846	31 48	
7B.	35,232	18,000	296,075	176,160	490,235 10% 539,258	25 31	
7A.	29,146	10,000	130,400	145,730	286,130 10% 314,743	20 80	
8	20,000	25,000	40,000	100,000	165,000 10% 181,000	19 08	
Total	381,000						

Tracts 1A, 1B, 2-3, and 4 can be irrigated by extending the present canals at a cost of about $6 per acre of land irrigated. Total area of irrigable land in these tracts is approximately 54,866 acres.

With reference to the preceding schedule it should be noted that the cost per irrigable acre was actually estimated from approximate information, covering all main, secondary and tertiary canals required in the district lying east of the present Alberta Railway and Irrigation Company's development. To cover the cost of the main supply canals and reservoirs an additional lump sum of $10 per irrigable acre has been added. The figures therefore should not be accepted as final.

REPORT ON THE SUNDIAL IRRIGATION AND WATER SUPPLY PROJECT.

By N. M. Sutherland, Inspecting Engineer.

Calgary, March 1, 1915.

I beg to submit herewith the following report dealing with the feasibility of diverting water from the Southern Alberta Land Company's canal and utilizing it for irrigation and domestic purposes on a tract of land (shown on the accompanying key plan) north of this canal and southwest of the Bow river, in ranges 18, 19, and 20, west of the 4th meridian.

When instructions to make surveys of this proposed project were received, the party was camped on Verdigris coulee, about five miles east of Warner, Alta., and consequently three days were lost in moving camp to sec. 30, tp. 12, rge. 19, west of the 4th meridian, about two miles south of Sundial post office.

Upon arriving at this location the following instructions were received from the commissioner:—

(1) The idea is to develop the possibilities of taking water from the Southern Alberta Land Company's system at some place below the Lake McGregor reservoir and carrying this water over such of the territory above described as may be commanded, principally for the domestic use or possibly the irrigation use of the settlers already in the district or who may come in the future.

(2) For the domestic use of the settlers it would appear that the only economical scheme will be to develop the possibilities of getting water out of the company's canal at some place, or a number of places, in ranges 18 to 21, and then turning the water into a natural channel or channels that traverse the district, and wherein the water would lie and be available for domestic uses. Or a short canal or a number of canals might be anticipated emptying into the natural channels.

(3) As above, for possible purposes of irrigation or a more comprehensive scheme of domestic supply, the construction of artificial channels serving the territory should be anticipated, or some system might be provided using short stretches of artificial channel and certain stretches of natural channel.

(4) In carrying on the work all natural channels should be carefully noted and sketched out if possible, and also all depressions or old lake beds not too heavily alkalied, which might be filled with water and made available for domestic purposes. Comprehensive notes should be kept which will facilitate the estimation at a later date of the cost of any canals or other works which may be projected in the office.

(5) The information should be developed by running levels over all the township lines and setting permanent iron bench-marks at the township corners in a similar manner and using the same limit or error as with the work which was done east of Lethbridge.

(6) All information possible should be collected regarding the wells, springs or other sources for the domestic supply of water which exist at the present time.

FIELD WORK.

In order that all levels run over the tract of country to be developed should have a sea-level datum, a line of check levels was run from a Dominion Government bench-mark in NE. ¼ sec. 36, tp. 11, rge. 20, west of the 4th meridian, along the east boundary of tp. 12, rge. 20, west of the 4th meridian, to a Dominion Government bench-mark placed in the NE. ¼ sec. 36, tp. 12, rge. 20, west of the 4th meridian; this latter bench-mark was taken as the datum elevation for all further levels.

The tract of country was developed by running levels along the boundaries of each township. In cases where it was thought that a considerable portion of the township could be irrigated, or where it was difficult to trace the topography of the town-

ship by means of levels along its boundaries alone, additional levels were run across the townships. Usually these additional levels were run from the centre of the north boundary to the centre of the south boundary and from the centre of the west boundary to the centre of the east boundary. While running these levels, notes were kept of the general topography of the country, by taking sights on knolls or objects on both sides of the road allowance levelled along, and their elevations and distances noted.

From the camp on the Little Bow river, levels were run west as far as this river, east to range 16, north to the north boundary of township 11 and south to the Little Bow river and the south boundary of township 12. A line of levels was run west from the NE. ¼ sec. 24, tp. 14, rge. 20, west of the 4th meridian, across the Little Bow on the Southern Alberta Land Company's reservoir, to the NE. ¼ sec. 24, tp. 14, rge. 21, west of the 4th meridian. This line was run to determine the elevation of the reservoir and also the feasibility of diverting water from the Southern Alberta Land Company's canal at as high an elevation as possible in the event of a canal line being run for irrigation purposes.

Upon completing the above levels, camp was moved to a spring in sec. 29, tp. 12, rge. 17, west of the 4th meridian. From this camp levels were continued as before to the west boundary of the Southern Alberta Land Company's tract, south of the south boundary of township 11, and north to the Alberta Land Company's tract in range 17 and to the north boundary of township 14 in range 18. In addition to levelling along the township lines, levels were run through the centre of all the townships in the above tracts with the exception of tp. 11, rge. 18, west of the 4th meridian. This township was found to be too high to be served from any canal which might be found feasible to divert from the Southern Alberta Land Company's system.

The above tracts include all the lands lying south of the Southern Alberta Land Company's canal. In order to develop the country lying north of this canal which could also be served by means of a diversion from the Southern Alberta Land Company's system, camp was moved to a point in sec. 30, tp. 15, rge. 18, west of the 4th meridian, three miles from Wheat Centre post office.

The following townships were levelled over in this tract:—

All of townships 15 and 16, range 18, west 4th meridian.

South half of township 17, range 18, west 4th meridian.

All of townships 15 and 16, range 19, west of 4th meridian.

Since practically all of the land in these townships is irrigable, additional levels were run across them to allow of a rough estimate of irrigable areas being made.

Having completed these levels, a small scale plan was made showing the elevations of all section and quarter section corners, and contours of twenty-five feet vertical intervals. It was determined from this plan that by diverting water from the Southern Alberta Land Company's canal just below the Little Bow reservoir at an elevation of about 2,770, and following north from there with a low grade canal that a considerable area could be commanded. Accordingly surveys were started for a canal from the Little Bow reservoir following the Southern Alberta Land Company's canal as far as a point in sec. 27, tp. 14, rge. 20, about 1,200 feet below the outlet gates from the Little Bow reservoir. From this point the general direction of the proposed diversion canal was northeast, following a grade of one foot per mile through tps. 14 and 15, rge. 20, west of the 4th meridian, tps. 15, 16, and 17, rge. 19, west of the 4th meridian, and tp. 17, rge. 18, west of the 4th meridian, as far as section 21, where it is proposed to turn the water into a coulee which drains into the Bow river in tp. 18, rge. 18, west of the 4th meridian. The approximate length of line run for this proposed canal was forty-eight miles and this represents fairly closely the actual length of a canal which would have to be constructed through this country in order to irrigate it. The many long detours necessary to carry the water around the heads of the long and flat valleys in tps. 15 and 16, rge. 19, west 4th meridian, makes this great length of canal necessary.

PRESENT WATER SUPPLY.

The water supply of the country lying south of the Southern Alberta Land Company's canal has been dealt with in a report submitted by Mr. V. Meek, C.E., so that only the supply of the country lying north of this canal will be dealt with here.

The conditions in this section of the country are similar to those met with in the greater part of southern Alberta, the water being usually of a fairly good quality when it is obtained at depths of from fifteen to twenty feet. The shallow wells are found in depressions and usually have a very fair supply of water. When water is obtained at depths varying from fifty to one hundred feet, the water is impregnated with iron and sodium salts, the water in such cases usually coming through blue clay. There are several such wells in this section and in some cases the water is almost unfit for use. Where wells have been drilled to depths of two hundred or more feet, the water obtained is of good quality and is free from salts.

Many of the farmers find it necessary to haul water for domestic uses, but it is usually found that these farmers have not seriously tried to obtain water by drilling.

A number of wells in this district are shown on the accompanying key plan, those with water free from iron and sodium salts are shown (⊙), while those with water of an inferior quality are shown (O).

The locations of several wells from which many farmers haul water are as follows: (1) well located on north and south road allowance on the east boundary of sec. 13, tp. 17, rge. 19, west of the 4th meridian; (2) well located on east and west road allowance, north boundary of sec. 19, tp. 16, rge. 18, west of the 4th meridian; (3) well located in sec. 17, tp. 16, rge. 18, west of the 4th meridian; (4) well in sec. 16, tp. 15, rge. 18, west of the 4th meridian; (5) well in sec. 15, tp. 15, rge. 19, west of the 4th meridian; (6) spring in sec. 2, tp. 15, rge. 20, west of the 4th meridian (approximate location). There are probably many more wells in this tract of country which have very good water and an attempt is being made to gather further information regarding the present water supply.

One of the principal objects in making these surveys was to determine the locations of canals to divert water from the Southern Alberta Land Company's canal at one or more points, and by means of canals, turn this water into natural watercourses so that it would run through the country and provide the settlers with water for domestic purposes. It was found, however, that the only feasible plan to supply water in this way would be to construct a canal, taking water from the outlet of the Little Bow reservoir, and bringing it north to about sec. 13, tp. 17, rge. 19, west of the 4th meridian, and at this point turning it into a large and deep coulee which heads about sec. 36, tp. 17, rge. 19, west of the 4th meridian, and runs south along the boundary between rges 18 and 19 in tp. 17 as far as the southeast corner of tp. 17, rge. 19. At this point it turns to the east and then follows south through the centres of tps. 16, 15, and 14 in rge. 18. In tp. 14, rge. 18, west of the 4th meridian, the watercourse widens out and forms the western part of a lake bottom in tp. 14, rges. 17 and 18, west of the 4th meridian. This lake bottom covers an area of several sections, and during a wet season would have considerable water drained into it.

In order to carry out the above scheme, it would be necessary to construct about forty miles of canal before water could be turned into a coulee and water can be obtained along the whole course of the coulee from wells. It is not believed to be desirable to turn water into a coulee along which better water can now be obtained from wells. For this reason the canal line was run with irrigation as the principal object in view and domestic supply of secondary consideration. The canal line was run at an elevation which would bring the largest possible area under the proposed canal, and if the present supply of water for domestic purposes proves inadequate, small diversion canals could be taken out of this main canal at various points to serve those who require a further supply.

TOPOGRAPHY OF THE COUNTRY.

As in the case of water supply, the topography of the country lying south of the Southern Alberta Land Company's canal has been dealt with by Mr. Meek.

Regarding the country lying north of this canal the drainage of the area developed, with the exception of a narrow strip on the east of tps. 15 and 16 in rge. 18, is all into the lake bottom in tp. 14, rges. 17 and 18, either by way of the coulee previously described, or by smaller watercourses.

The NE. ¼ of tp. 14, and the SE ¼ of tp. 15 in rge. 20, west of the 4th meridian, are commanded by the proposed canal. Both of these townships are very rolling and hilly and are not suitable for irrigation.

Tp. 14, rge. 19, west of the 4th meridian, is not crossed by the proposed canal, but the greater part of the township is commanded by it. This township is rolling in the west and south, but the SE. ¼ is of even slope and is irrigable.

Tp. 15, rge. 19, west of the 4th meridian, is rolling in the southeast, and in the centre of the township there is a high ridge running east and west which cannot be served. The slopes of this ridge are gentle and are irrigable.

Tp. 16, rge. 19, west of the 4th meridian, is for the greater part too high and like township 15, it has a ridge running across it about the centre. The SE. ¼ is even and irrigable as is also a strip two miles wide along the north of the township.

In tp. 17, rge. 19, west of the 4th meridian, sections 1 to 5 are the parts of this township which can be irrigated from the proposed canal. This township is very rolling and hilly and rises rapidly to the north.

In rge. 18, all of tps. 14, 15, and 16 can be served by the canal and also the SE. ¼ of tp. 17.

Tp. 14, rge. 18, is rolling in the west and north but is very flat in the southeast. Townships 15 and 16 have a coulee, which has been previously described, running south through their centres. The eastern portions of these townships drain east to the Bow river, and the remainder drains into the coulee. Township 15 is fairly even and the greater part can be irrigated. Township 16 is more or less rolling.

The portion of township 17 which lies under the proposed canal has a very even and gentle slope to the east. To the west and north of the township the land rises rapidly to the high hills lying west of the Bow river.

The soil throughout the above tract is a light sandy loam.

IRRIGABLE AREA.

The total amount of land in the above townships which lie under the elevation of the proposed canal is 141,400 acres. It is considered that 50 per cent of this amount, or 70,700 acres are irrigable.

REPORT ON THE SUNDIAL IRRIGATION AND WATER SUPPLY PROJECT.

By V. Meek, Inspecting Engineer.

Calgary, March 1, 1915.

I beg to submit herewith a preliminary report as to the feasibility of diverting water from the Southern Alberta Land Company's canal, to the country lying south of this canal and north of the Little Bow and Belly rivers in ranges 17, 18, 19, and 20 west of the 4th meridian for irrigation and domestic purposes.

Following instructions the field work for this scheme was begun on October 20. Mr. Sutherland had already completed a system of levels over the township lines, and in some cases, through the middle of townships. From these levels the twenty-five foot contours (shown on key plan submitted) were sketched. While these contours

are not accurate in detail, they give a general idea of the topography of the country. A ridge beginning in tp. 15, rge. 20, west of the 4th meridian, extends southeasterly along the Little Bow and Belly rivers. Between this ridge, and the Southern Alberta Land Company's canal there is a broad valley which commences in tp. 14, rge. 19, west of the 4th meridian, and drains southeasterly through tp. 13, rges. 18 and 19, west of the 4th meridian. A coulee heading in sec. 36, tp. 12, rge. 18, west of the 4th meridian drains southeasterly to the Belly river (see key plan). From a study of this topography and the elevations along the Southern Alberta Land Company's canal it was found:—

(1) That the northerly slope of the above mentioned valleys could be irrigated by a canal along the ridge.

(2) That the highest feasible location for an intake to such a canal would be just above the first "drop" on the Southern Alberta Land Company's canal, in sec. 8, tp. 14, rge. 19, west of the 4th meridian (as shown on key plan) at the beginning of line "C."

NOTE.—It would probably be possible to obtain an additional elevation of approximately thirty feet by locating the intake at the head of the Southern Alberta Land Company's reservoir in tp. 14, rge. 20, west of the 4th meridian, but this would necessitate the construction of fifteen miles of additional canal running parallel to the Southern Alberta Land Company's canal, thus greatly increasing the cost of the project for a small amount of additional land made irrigable.

(3) That the southerly slope of this ridge towards the Little Bow and Belly rivers is at too high an elevation to be irrigated by water from the Southern Alberta Land Company's canal.

(4) That part of the higher land to the north of the valley in tp. 13, rge. 19, west of the 4th meridian could be irrigated by a second canal having an intake below the first "drop" in the Southern Alberta Land Company's canal in sec. 4, tp. 14, rge. 19, west of the 4th meridian.

A preliminary traverse of these two canals shown on key plan as lines "A and C" was run in the field. Sufficient levels were taken along the centre line from which to plot an accurate profile, and sufficient topography taken on either side of the line from which to project a location, and estimate the earthwork. A traverse was also made of the valley, shown as line "B" on key plan, and information collected regarding the present water supply of the district. All these lines were plotted on a large plan to the scale of 400 feet to the inch, from which they were sketched on the key plan as shown. The dotted portion of line "C" in range 17 was projected directly on the contour plan, there not being sufficient time to actually run this line in the field.

From the traverse made of the valley, commencing at the Southern Alberta Land Company's canal, in sec. 4, tp. 14, rge. 19, west of the 4th meridian, it was found that if water were turned into this valley it would not flow freely through the country. There is no well defined channel, and the lowest part of the valley consists of a succession of old lake bottoms with ridges averaging ten feet in height between them. In many cases there is practically no difference between consecutive lake bottoms, and the water, if allowed to flow freely through the country, would spread out and flood a large area of land. Further, good wells are already located all along this valley, and even if a watercourse could be created at small expense, it would only directly serve farms which already have an adequate supply of water for domestic uses, while settlers on the higher lands, who have not been able to find water on their farms would still have to haul water the same distance as at present. Hence, the only feasible scheme for a domestic supply of water would be a small canal located at as high an elevation as possible along the ridge, such as line "C," but even such a canal would benefit very few farmers.

The present water supply for this district is entirely from wells and springs. The location of some of the best of these wells is shown on the key plan. Along the

valley, indicated on key plan as line "B," good water can as a general rule be obtained at a depth of from ten to twenty feet, although in some cases the water is too heavily alkalied for drinking purposes. In the SW ¼ of sec. 29, tp. 12, rge. 17, west of the 4th meridian, there is a particularly good spring, from which the town of Retlaw secures its drinking water, the wells in the town being strongly charged with soda and iron. This spring also supplies a number of farmers to the northeast, and one or two on the ridge to the south. Farther down the coulee, in which this spring is located, are other good wells. Farther west in tps. 12 and 13, rge. 18, west of the 4th meridian, almost all of the settlers have sufficient water from wells on their own lands. In the NW. ¼ of sec. 31, tp. 12, rge. 18, west of the 4th meridian, is a second government well containing good water at a depth of fifteen feet, but in a dry summer it only yields a few barrels a day.

In tps. 12 and 13, rge. 19, west of the 4th meridian, and west to the Little Bow river, there seems to be sufficient water for domestic use with the exception of some sections along the ridge running parallel to the Little Bow river and some sections northeast of Sundial Post Office. A number of these people secure their water from a spring located in the NE. ¼ of sec. 21, tp. 12, rge. 19, west of the 4th meridian. Considering the district as a whole, there are comparatively few settlers who have to haul water for domestic use. What the great majority of the people require is water for irrigation purposes.

The land irrigable from canal "C" lies in two tracts, shown hatched on key plan and roughly estimated at 10,000 acres each. The rest of the land commanded by this canal is too rough to be profitably irrigated. A third tract of 3,000 acres can be irrigated from canal "A." The land in tps. 12 and 13, rge. 13, west of the 4th meridian, is for the most part a clay loam, while the lower irrigable tract in township 11, commanded by canal "C," is a lighter loam. All the land shown as irrigable can be readily drained and is thought to be suitable for irrigation.

Assuming that water can be obtained from the Southern Alberta Land Company's canal, it would seem to be quite feasible to irrigate the land shown on the key plan at a moderate cost. The main canal would be approximately thirty-five miles long and of easy construction with no engineering difficulties. The land would certainly be greatly benefited by an irrigation system, since for the past four years the crops have been practically failures, and numbers of the settlers have left the district on this account. A system of water supply solely for domestic purposes is not feasible for the reason that the small number of settlers who would benefit by such a scheme would not justify the expenditure involved.

REPORT ON THE OLDMAN RIVER IRRIGATION PROJECT.

By V. Meek, Inspecting Engineer.

Calgary, March 1, 1915.

I have the honour to submit herewith a report on the Oldman River Irrigation project.

During the year 1913 preliminary surveys were made to determine the feasibility of this scheme, and a report on this work will be found in the annual report for that year. Although this report showed conclusively that the project is feasible, more detailed surveys were necessary in order to more accurately define the irrigable areas and estimate the cost of construction. Surveys with this primary object in view were continued during the field season of 1914.

FIELD WORK.

Organization of Party.—A party was organized along the same lines as the previous year, comprising twelve men with a field equipment consisting of six horses, one wagon, two democrats, and six tents.

The party was outfitted in Lethbridge, taking the field on May 9. The surveys were finished on October 17, a working period of 139 days, during which time there were completed 212 miles of traverse, including levels and topography, and 1,212 miles of stadia levels along section lines.

Canal Surveys.—Since from last year's survey, line "B" was proved to be the most feasible location for a canal to serve the land under consideration, the preliminary location for this line was continued and also some additional work was done on the upper end of this line, near the intake, in running alternative lines to secure a better grade location and a shorter crossing of the Oldman river.

All elevations were referred to the same datum as the previous year, but the levels were tied to the Dominion Geodetic Survey bench-marks No. 80 D and No. 81 D, established at Kipp and Mile 5, on the Aldersyde Branch of the Canadian Pacific Railway. The equation to be used to reduce any levels on the Oldman River survey to government sea-level datum is +11·02 feet.

All the main canal for the system and for most of the laterals over 40 second-feet capacity were approximately located in the field, and the projected locations are shown in the accompanying general plan.

Main Features of System.—The proposed intake for the main canal is located on the south side of the Oldman river, about six miles west of Macleod, at a water surface elevation of 3,210 feet. The diversion works consist of a simple overflow weir 600 feet long, with a maximum height above the present river bed of six feet. The headgate is a continuation of the weir and is designed of concrete to give a maximum discharge of 1,200 second-feet. From the intake the canal follows along the south bank of the river for a distance of three and one-half miles, then crosses to the north side by means of a flume 3,600 feet long with a maximum height of forty-four feet. This will be the largest and most costly structure on the whole system. The necessity of locating the intake on the south side of the river was fully discussed in the previous year's report.

From this point to the Keho Lake reservoir, a distance of fifty miles, the main canal follows a grade location through country with easy slopes, and should be of light construction with the exception of a "cut," one and one-half miles long, with a maximum depth of thirty-five feet, for an intake to the reservoir. This heavy "cut" could not be avoided because, on account of the depression extending from the Oldman to the Little Bow rivers in range 24, a canal could not be located on grade at a higher elevation. The main structures on this section are trestle flumes crossing Willow creek and Rocky coulee, where spillways are provided.

The canal reaches the beginning of the proposed irrigable areas at a point approximately thirty miles from the intake, and in this irrigable tract above the reservoir preliminary lines were surveyed for the South Branch and secondaries "C," "E," and "F." (See general plan.)

The outlet from the Keho Lake reservoir is located at a water surface elevation of 3,130 feet, giving an available storage of 41,000 acre-feet. To provide this storage a cut two miles long with a maximum depth of twenty feet is necessary through secs. 33 and 34, tp. 11, rge. 22. From the end of this cut the Kipp branch was located running in a southerly direction and serving the land in tps. 9 and 10, rge. 22, and secondary "G" in a northerly direction skirting the Black Spring ridge and serving some irrigable areas in tps. 11 and 12, rge. 21.

The irrigable tract in the vicinity of Iron Springs lies at a general elevation of 250 feet below the Keho Lake reservoir, and some system had to be devised to drop the water through this distance. In order to save part of the cost of an expensive drop line the main canal is diverted into the head of Pyami coulee and allowed to flow down this natural channel to sec. 6, tp. 11, rge. 21, where the coulee flattens out and water for the Turin branch can be diverted by means of a small dam, thus dropping the water through a total vertical distance of 120 feet at small cost. From this point, the Turin branch is run on as high a grade as possible with a limiting velocity of 2·8 feet per second, and the additional elevation is taken up by vertical concrete drops.

Alternative schemes.—As an alternative to this whole scheme as projected, it was suggested that as the most urgent demand for water was from the Iron Springs district, which has an average elevation below the Keho reservoir of 250 feet, if instead of dropping the water this 250 feet through an artificial channel it were possible to come down the Oldman river with an intake to this elevation, and get away from the river banks with a canal, it should be possible to irrigate this tract of land east of Keho lake more cheaply than from the proposed system.

From a study of the contour township sheets the lowest feasible location for such a canal to serve the Iron Springs district would be at an elevation of approximately 3,000 feet in township 10, range 21, in order to avoid numerous coulees in this township. A grade canal at this elevation would run into the cut banks of the Belly river opposite Kipp in township 9, range 22. Further, the lowest feasible location for a canal crossing township 10, range 24, would be at 3,080 feet and such a canal would run into the steep banks of the Oldman river in sec. 20, tp. 10, rge. 24, at which point the approximate elevation of the water surface of the Oldman river is 2,920 feet necessitating a dam 160 feet high and probably 4,000 feet long. Considering the small area of land served, the cost of such a dam would certainly be excessive, and this scheme is not considered feasible.

The canal system as projected has an intake at the water surface of the Oldman river at an elevation of 3,210 feet. Locating the intake at a lower elevation, it would not be possible to use the Keho reservoir, and a canal at a lower elevation would get into difficulties with coulees and cut banks along Willow creek and the Oldman river in tp. 9, rge. 26, and tps. 9 and 10, rge. 25. As the previous surveys eliminated any canal system at a higher elevation, it is proved that the projected location is the most feasible for a canal to irrigate the land shown on the general plan, or the Iron Springs district alone, with the exception that if a smaller area were irrigated the Keho reservoir would not be necessary and could be eliminated by having the main canal follow along the ridge on the north side of township 10, range 23, as shown on general plan by the location of the South and Kipp branches.

Contour Surveys.—In order to more accurately estimate the irrigable areas, a system of stadia levels was run over all the section lines of the tracts known to be commanded by the ditches, from the previous year's surveys. Side notes were kept showing the character of the land and the percentage of each quarter-section estimated to be irrigable. Temporary bench-marks were placed at each section corner and the maximum error of closure allowed was $\cdot 10\sqrt{}$distance in miles. These notes were plotted on contour sheets to a scale of forty chains to the inch and ten feet contours located.

The topographic surveys were kept in advance of the canal location surveys and in this manner the most feasible canal routes were first projected roughly on the contour sheets, thus greatly simplifying the field work.

Soil Surveys.—To prove the suitability of the soil for irrigation ten groups of samples were collected during the field season, each group consisting of three samples taken at various depths down to five feet, the groups being typical of the various irrigable tracts. The samples were shipped to Ottawa for analysis but the results are not yet available.

RESERVOIRS.

In order to irrigate 100,000 acres the Oldman river during a dry year such as 1910 when the discharge falls below 500 second-feet in July and August (see hydrograph plate 1), a reservoir with a capacity of at least 40,000 acre-feet is necessary. This required capacity depends on the "duty" of water, which will be discussed under "design of canals." The most suitable reservoir site for this purpose is that at Keho lake, as shown on the general plan of the project.

Keho Lake Reservoir Site.—This reservoir site lies in a natural depression between the Black Spring ridge and the high land about Noble. The elevation of the bottom is 3,130 feet and the depression is separated from Pyami coulee by a ridge with a maximum elevation of 3,150 feet and hence up to this elevation no dam is required but two heavy "cuts" are necessary to get the water into and out of this depression. The available storage at a high-water level of 3,145 feet as designed, amounts to 41,000 acre-feet. This would flood an area of 3,690 acres. The greater part of the flooded area is very poor land and the average value of the whole area has been taken at $10 per acre.

The total cost of this reservoir would be approximately as follows:—

3,690 acres of land flooded at $10 per acre..	$ 36,900
665,490 cubic yards excavation for intake at 20 cents..	133,098
552,560 cubic yards excavation for outlet at 20 cents..	110,512
Or a cost of $6.62 per acre-foot.	$283,610

Other Reservoir Sites.—Mr. G. H. Whyte made a report on a proposed reservoir site on the headwaters of the Crowsnest river at Crowsnest and Island lakes, showing an available storage of 3,800 acre-feet. This storage is too small for this project, but it might be of use to supply water to the Oldman river for riparian rights when the total natural flow is diverted for irrigation.

A third reservoir site, which might be used in connection with this project, is on the Oldman river at the "Gap" in SW ¼ sec. 33, tp. 10, rge. 3, west of the 5th meridian. Mr. Peters' report of August 19, 1911, on this site shows the available storage to be 23,660 acre-feet at a cost of $200,000.

The Keho lake site is the only one at present known which has a sufficient capacity for this project in a dry year, and it has the further advantage of being centrally located with respect to the land to be irrigated.

IRRIGABLE AREAS.

As previously stated under "contour surveys" the percentage of irrigable land in each quarter-section was estimated in the field and the information collected on the contour sheets of townships. Land which could not be readily drained or was too rough or heavily alkalied was not considered irrigable. A summary of the areas considered irrigable in each township as shown on the general plan is as follows:—

Tract A, including all the land above Keho Reservoir—

Tp. 10,	rge. 25,	west of 4th meridian..	3,390	acres.
" 11,	" 25,	" "	4,150	"
" 12,	" 25,	" "	1,180	"
" 10,	" 24,	" "	3,600	"
" 11,	" 24,	" "	5,370	"
" 12,	" 24,	" "	1,970	"
" 13,	" 24,	" "	1,970	"
" 10,	" 23,	" "	8,500	"
" 12,	" 23,	" "	6,360	"
" 13,	" 23,	" "	8,520	"
Say 44,000 acres.			44,040	"

Plate I.

Department of the Interior

IRRIGATION BRANCH

HYDROGRAPH

OF

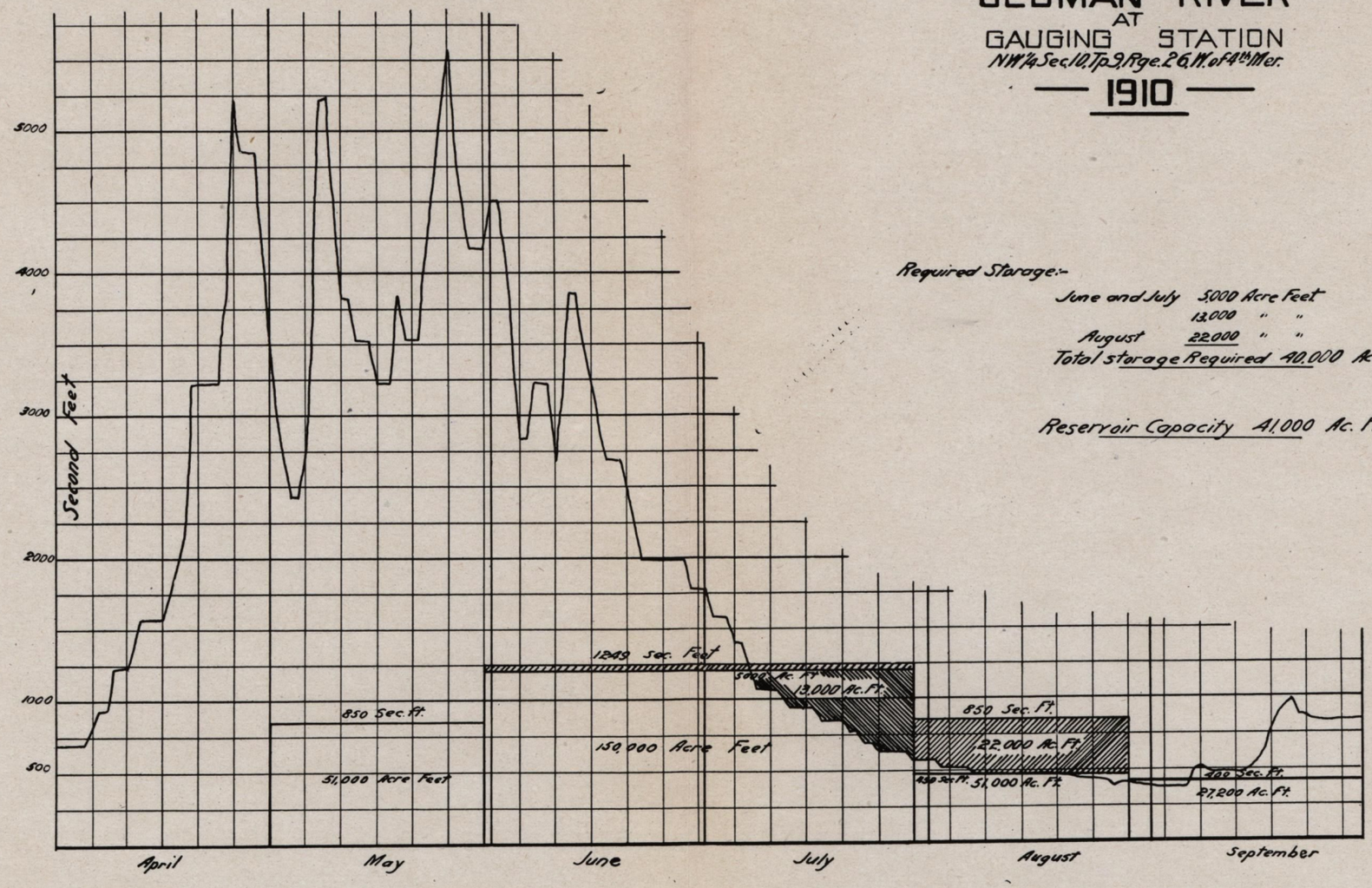
OLOMAN RIVER

AT

GAUGING STATION

NW¼ Sec. 10, Tp. 9, Rge. 26 W. of 4th Mer.

1910



Required Storage:-

June and July 5,000 Acre Feet
" " 13,000 " "
August 22,000 " "
Total storage Required 40,000 Ac. Ft.

Reservoir Capacity 41,000 Ac. Ft.

W. J. G. April 1915.

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Plate II.

Department of the Interior

IRRIGATION BRANCH

HYDROGRAPH

OF

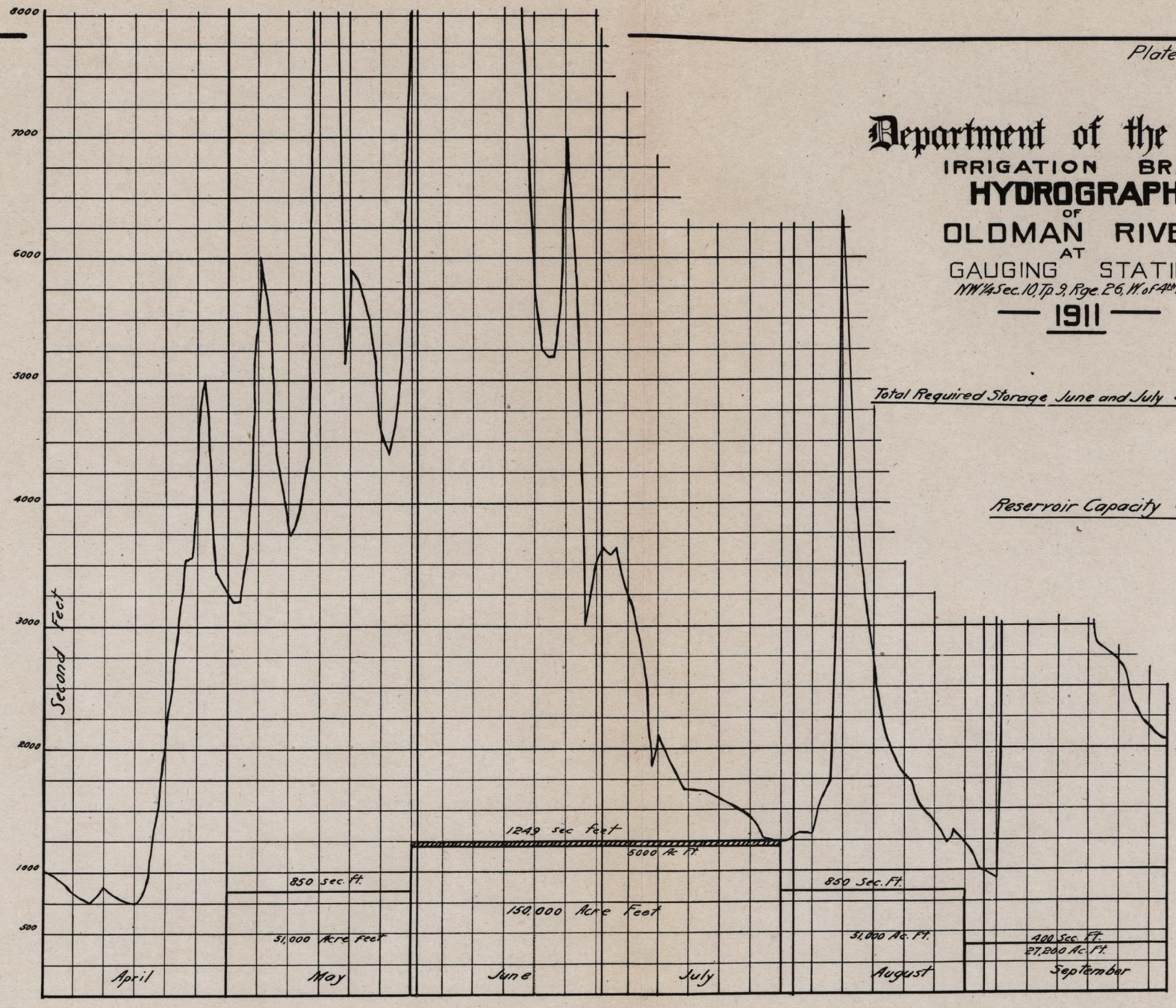
OLDMAN RIVER

AT

GAUGING STATION

NW¼ Sec. 10, Tp 9, Rge. 26, W. of 4th Mer.

— 1911 —



Total Required Storage June and July 5000 Acre Feet.

Reservoir Capacity 41,000 Ac. Ft.

W.J.G. April 1915.

84696—7

Plate III.

Department of the Interior

IRRIGATION BRANCH

HYDROGRAPH

OF

OLDMAN RIVER

AT

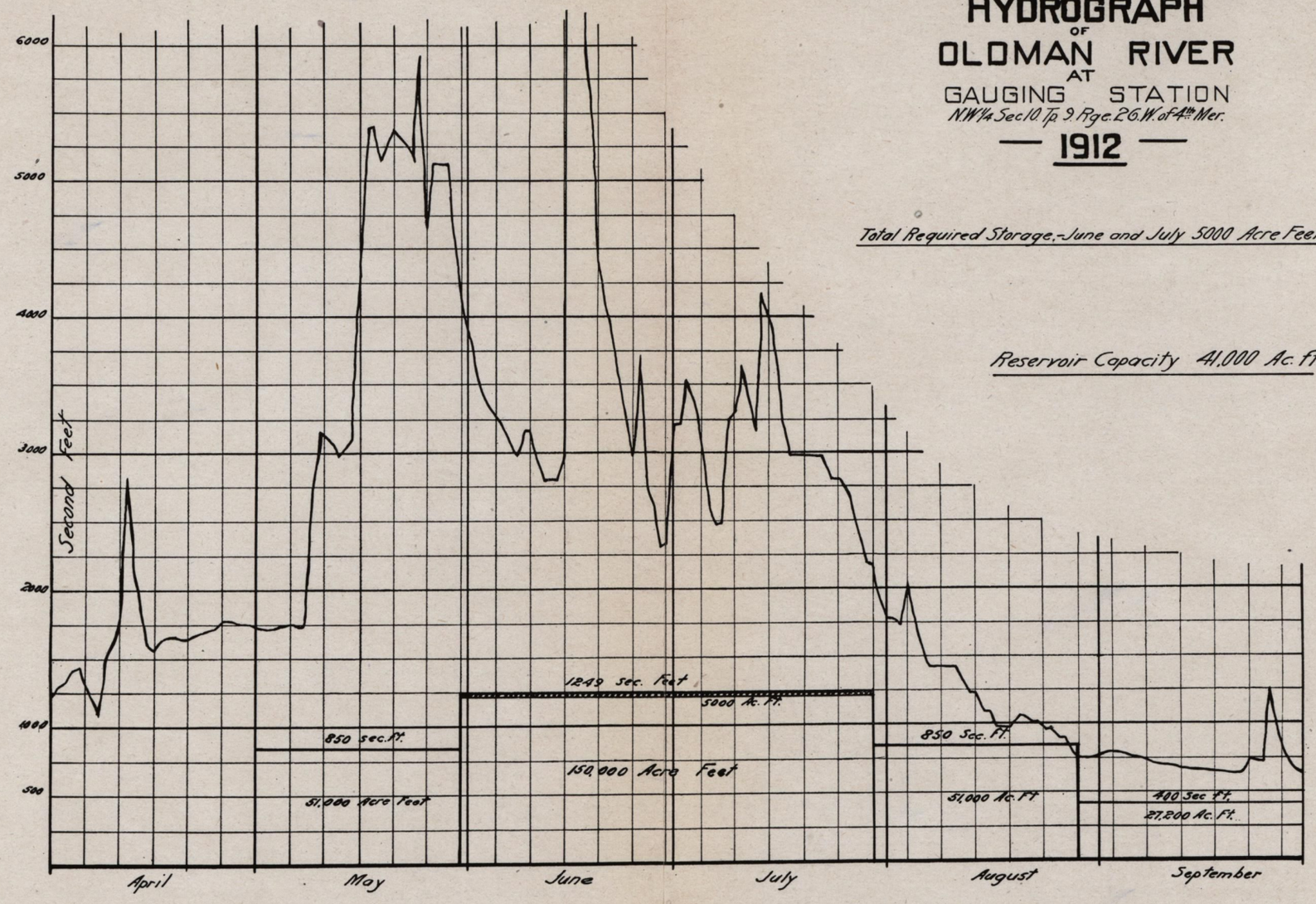
GAUGING STATION

N.W.¼ Sec 10 Tp. 9 Rge. 26 W. of 4th Mer.

1912

Total Required Storage,-June and July 5000 Acre Feet.

Reservoir Capacity 41,000 Ac. Ft..



W. J. G. April 1915.

Plate IV.

Department of the Interior

IRRIGATION BRANCH

HYDROGRAPH

of

OLDMAN RIVER

AT

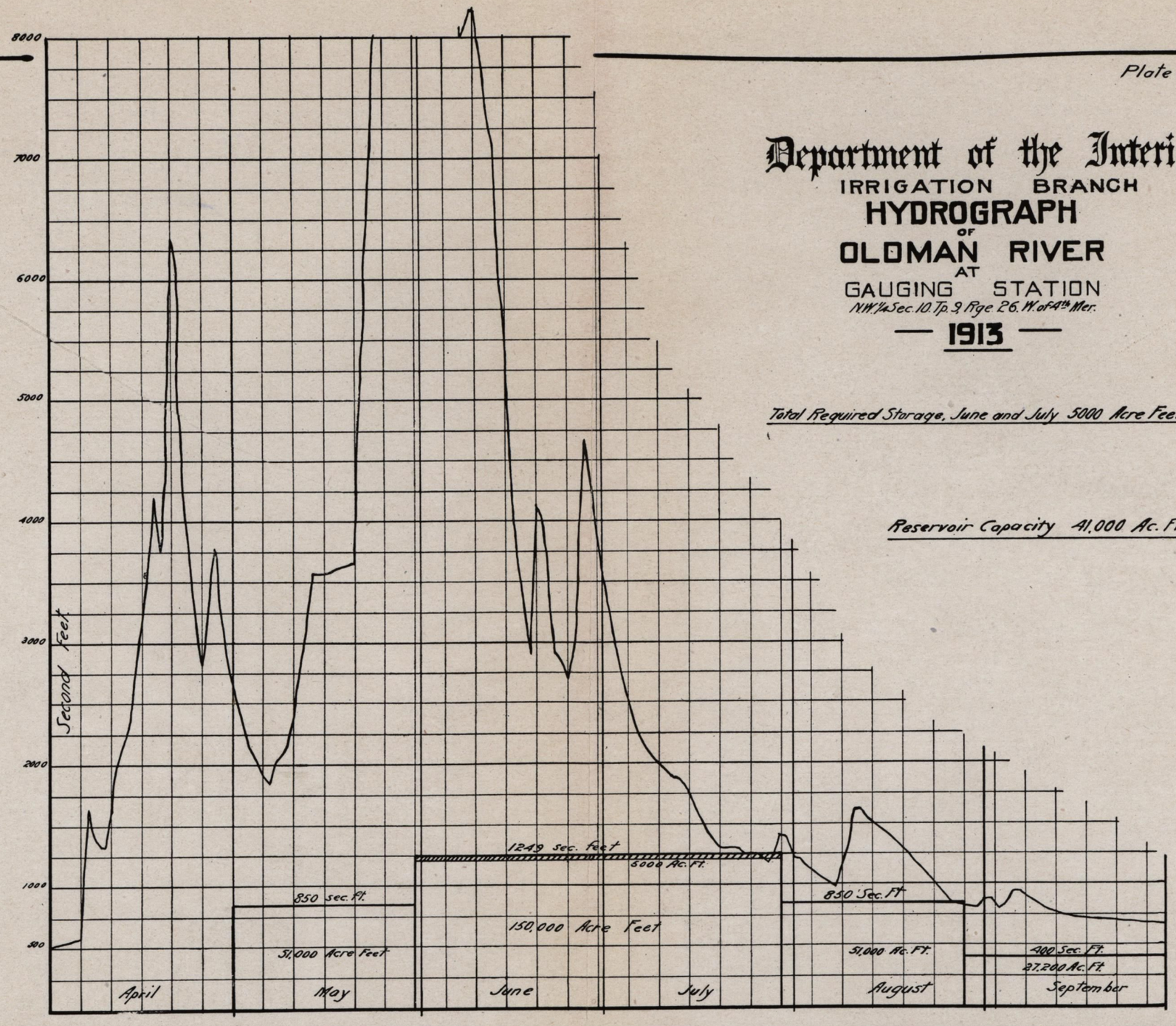
GAUGING STATION

NW¼ Sec. 10. Tp. 9. Rge. 26. W. of 4th Mer.

— 1913 —

Total Required Storage, June and July 5000 Acre Feet.

Reservoir Capacity 41,000 Ac. Ft.



W.J.G. April 1915.

84696—9

Plate V.

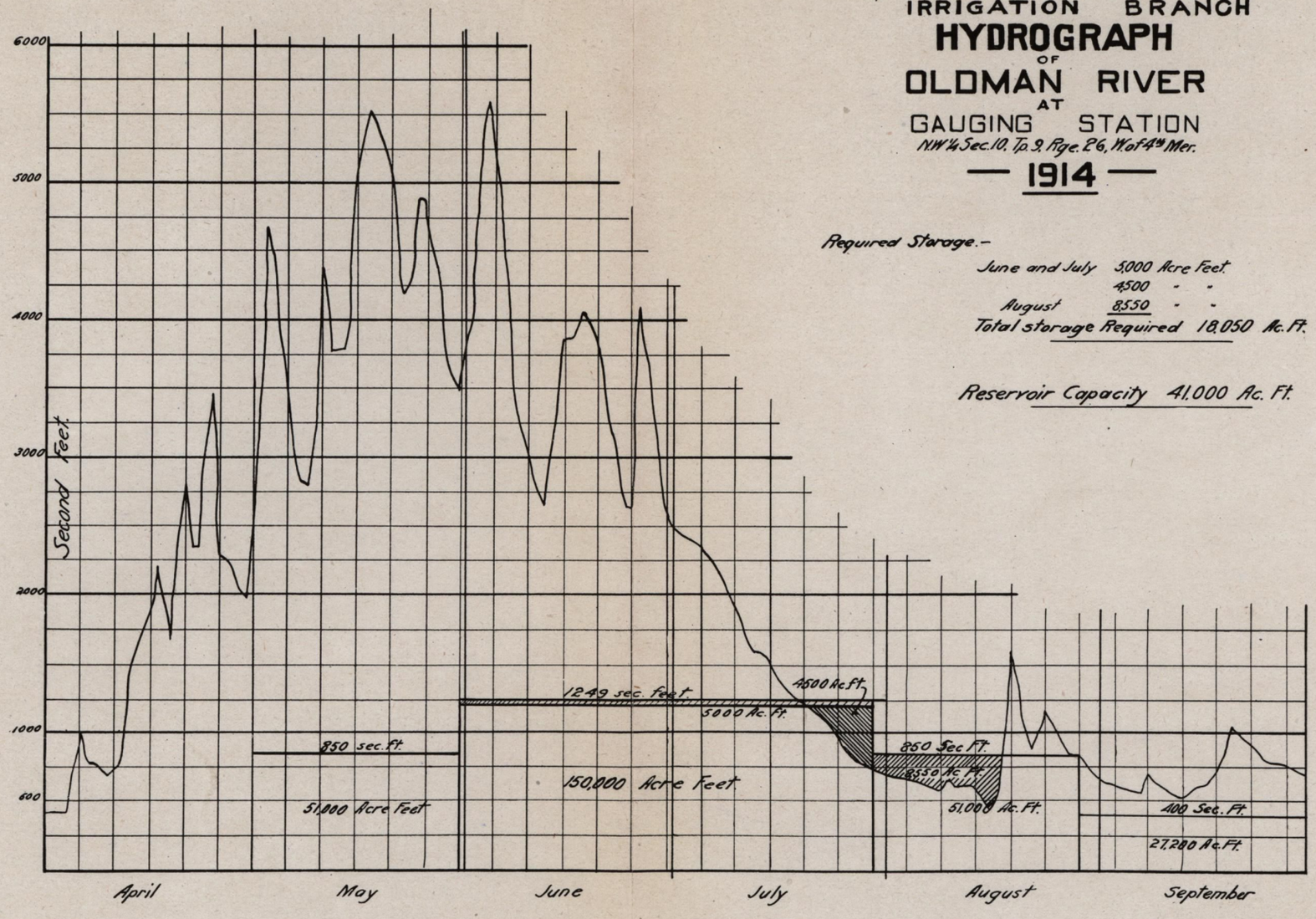
Department of the Interior

IRRIGATION BRANCH

HYDROGRAPH OF OLDMAN RIVER AT GAUGING STATION

NW¼ Sec. 10, Tp. 9, Rge. 26, W of 4th Mer.

— 1914 —



Required Storage.–

June and July	5000	Acre Feet.
	4500	- -
August	8550	- -
Total storage Required	18,050	Ac. Ft.

Reservoir Capacity 41,000 Ac. Ft.

W.J.G. April 1915

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Tract B, including all the land below Keho Reservoir—

Tp.	9,	rge.	22,	west of	4th meridian	4,940 acres.
"	10,	"	22,	"	"	7,850 "
"	11,	"	22,	"	"	2,770 "
"	10,	"	21,	"	"	4,110 "
"	11,	"	21,	"	"	13,520 "
"	12,	"	21,	"	"	3,420 "
"	10,	"	20,	"	"	1,310 "
"	11,	"	20,	"	"	11,330 "
"	12,	"	20,	"	"	320 "
"	11,	"	19,	"	"	4,790 "
"	12,	"	19,	"	"	3,210 "
Say 57,000 acres, or a total of 101,000 acres.						57,570 "

This estimate, while necessarily approximate, is thought to be correct within ten per cent. The total area of quarter-sections to which it is proposed to deliver water as shown on the general plan is 169,800 acres. The land considered irrigable amounts to 59·5 per cent of this area.

HYDROGRAPHS.

The available water in the Oldman river from April to September for the years 1910 to 1914 is shown by the accompanying hydrograph plates I to V. These were prepared from data for the gauging station near Macleod at NW ¼ sec. 10, tp. 9, rge. 26, W. of 4th meridian, and should closely approximate the discharge of the Oldman river at the intake. As the year 1910 shows the lowest discharge for the five years during which records were kept, all calculations for canal and reservoir capacities were based on the available water during this year.

DESIGN OF CANALS.

Maximum Irrigation Requirements.—As discussed fully in last year's report, the maximum required amount of net water governing the capacity of the canals has been assumed to be 6 inches of water over 50 per cent of the irrigable area in a period of fifteen days.

This is based on the following assumptions:—

(1) That 6 inches is the average depth of water required for one irrigation in southern Alberta.

(2) That fifteen days is the length of the critical period of maximum water requirement, during which time the majority of the crops must receive one irrigation to secure the best results.

(3) That in any one year an average of twenty per cent of the irrigable area will be unirrigated, and that a further average of thirty per cent of the irrigable area will be in crops which will not affect this fifteen day period of maximum water requirement, i.e., this 30 per cent can be irrigated at an earlier or later time without suffering injury. This leaves fifty per cent of the total irrigable area to receive one irrigation in fifteen days.

The canal system has been designed to supply this maximum quantity of water at the farm deliveries, and allowances have been made for seepage and evaporation losses, and also with canals carrying less than 40 s.f. an additional capacity has been provided to allow for rotation.

Farm Units.—As the irrigable area of this project is already settled, the farm units, to which individual delivery has been provided for, were taken as 160 acres. Hence each quarter-section will have a separate delivery whether the whole 160 acres have been considered irrigable or only a small portion. The projected location of all canals and laterals is shown on the general plan accompanying this report.

Seepage and Evaporation Losses.—Table No. 1 shows the maximum irrigation requirements and seepage losses estimated on a basis of daily loss in feet over the wetted area of all canals. The assumed daily loss of ·75 foot has been taken as an average of the actual measured losses on a number of canals of the United States Reclamation Service constructed through clay and loam, and sand and clay, and should be a fair average for this project, although no very definite information has yet been obtained with regard to subsoil conditions.

The first few miles of main canal from the intake will be in sand and gravel, and until the canal bed becomes silted the losses will be heavy. An assumed daily loss of 1·5 feet has been taken for this portion of the main canal. The total seepage losses for the system amounts to thirty-four per cent of the maximum quantity of water diverted. The evaporation and seepage losses in the reservoir are not included but have been provided for when considering the total amount of water required with respect to the amount available.

The following table gives the total percentage of water diverted, which was lost in canals and laterals on six different irrigation projects in the United States during the year 1911:—

Project.	Percentage losses in canals and laterals.
Umatilla	32
Truckee-Carson	41
Orland	23
Klamath	48
Tieton	24
Sunnyside	27

Average loss = 33 per cent.

The average loss on these six projects, of 44 per cent, agrees very closely with the estimated loss of 34 per cent on the Oldman River project.

Duty of Water.—The duty of water, upon which depends the total requirements for the irrigation season and the necessary reservoir capacities if any, is in a very unsatisfactory condition. The law in Canada, as at present framed, requires one second-foot of water for each 150 acres irrigated, which is equivalent to two acre-feet per irrigated acre, but no allowance has been made for an irrigation factor or for supplying an increased amount of water at critical periods when most needed. Further, this legal duty of water is now considered to be too low, judging from the results obtained by using a less amount of water on systems already in operation in Alberta and Montana.

According to the best information obtainable, the amount of water diverted in the Milk River valley, Montana, where records have been kept since 1905, has been 1·13 acre-feet per acre actually irrigated, and the area irrigated in each year averaged sixty-five per cent of the total irrigable area.

On the Alberta Railway and Irrigation Company's system near Lethbridge, only a few miles south of the area proposed to be irrigated from the Oldman river, good results have been obtained, with an average amount of water diverted of 1·31 acre-feet per acre irrigated, and the average area irrigated has been fifty-nine per cent of the total irrigable area.

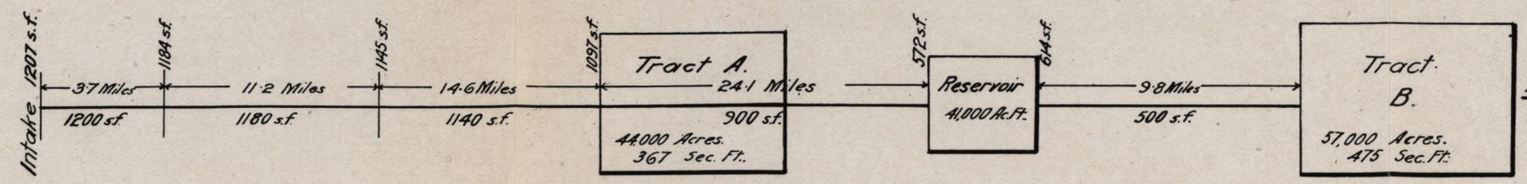
It is now considered that for large projects in southern Alberta where alfalfa and grain are the principal crops irrigated, the greatest requirement would probably be 1·5 acre-feet of water per acre irrigated, and that it would be safe to assume that in any one year only eighty per cent of the total irrigable area would be irrigated.

OLDMAN RIVER PROJECT

Estimated Seepage Losses and Maximum Canal Capacities for period of Maximum Draft, June 1st to July 30th.

DISTRICT	NET IRRIGATION REQUIREMENTS			SEEPAGE FACTORS												Total Seepage loss in District.	Net Water for Irrigation on land. c.ft.sec.	Maximum Main Canal Capacity. in District.	REMARKS
	Approximate Total Irrigable Area	Required Max.m Quantity of Net Water		Main Canal		Laterals		Canal Factors					Daily loss in Feet over Wetted Areas	Loss in Acre Feet	Loss in Sec. Feet				
		Acre feet	C.Ft.Sec.	Mean Capacity c.ft.sec.	Length in Miles.	Mean Capacity c.ft.sec.	Length in Miles.	Base	Depth	Side Slopes	Wetted Perimeter Width in Feet.	Wetted Perimeter Area in Acres.							
TRACT BELOW KEHO RESERVOIR						25	69·3	2·5	1·0	1 to 1	5·3	44·5	·75	33·4	16·7				
						5	40·8	3	1·0		5·8	28·7	·75	21·6	10·8				
						10	32·1	3	1·5	1 to 1	7·2	28·0	·75	21·0	10·5				
						15	23·9	3·5	1·5	1½ to 1	8·7	26·2	·75	18·9	9·4				
						20	13·4	4	2·0		11·2	18·3	·75	13·7	6·8				
						30	18·0	4	2·5		12·14	26·4	·75	19·8	9·9				
						40	25·4	4	3·0		14·8	45·6	·75	34·2	17·1				
						50	3·7	5	3·2		16·6	7·4	·75	5·5	2·8				
						70	3·2	6	3·6	1½ to 1	18·8	7·3	·75	5·5	2·7				
						100	8·1	7	4·0	2 to 1	21·4	20·9	·75	15·7	8·8				
						150	12·5	10	4·0		24·4	36·9	·75	27·6	13·8				
						350	4·3	15	6·0		36·6	19·2	·75	14·4	7·2				
				500	9·8			24	6·0	2 to 1	30·8	60·2	·75	45·1	22·6	139			
	57,000	57,000	475														475	614	Intake at Keho Reservoir
TRACT ABOVE KEHO RESERVOIR						25	64·3	2·5	1·0		5·3	41·3	·75	31·0	15·5				
						5	24·0	3	1·0		5·8	16·8	·75	12·6	6·3				
						10	29·2	3	1·5		7·2	25·5	·75	19·1	9·6				
						15	15·5	3·5	1·5		8·7	16·8	·75	12·6	6·3				
						20	11·4	4	2·0		11·2	15·5	·75	11·6	5·8				
						30	12·2	4	2·5		12·14	18·0	·75	13·5	6·7				
						40	15·0	4	3·0		14·8	26·9	·75	20·2	10·1				
						70	9·0	6	3·6		18·8	20·5	·75	15·4	7·7				
						100	13·5	7	4·0		21·4	35·0	·75	26·2	13·1				
						150	3·2	10	4·0		24·4	5·6	·75	4·2	2·1				
				900	24·1			32	8·0	2 to 1	67·8	197·1	·75	147·8	73·9	158			
	44,000	44,000	367														367	1097	42 Sec. Ft. used from Keho Reservoir.
MAIN CANAL				1140	14·6			36	8·0	2 to 1	71·8	127·0	·75	95·4	47·7				
				1180	11·2			37	8·0	2 to 1	72·8	98·6	·80	78·8	39·4				
					3·7			36	8·5	1½ to 1	66·6	30·2	1·5	45·2	22·6	110		1207	Intake at Oldman River.

Sketch of Main Canal System.



Note:- Total seepage loss = 34% of Maximum Discharge.

W.J.G. Mar 1915.

Still, since the department cannot at present issue a license to a scheme supplying less than the legal duty of two acre-feet per acre irrigated, the following total requirements for the different months of the irrigation season have been assumed:—

—	May.	June.	July.	August.	Septen.ber.
Inches of water....	4	6	6	4	2
	30 days.	60 days.		30 days.	34 days.

This is equivalent to 1·83 acre-feet per acre delivered to the entire irrigable area. This is a slightly higher "duty" than the legal requirement of two acre-feet per acre, but on the other hand the estimate is based on the available water in the year 1910, which is an exceptionally low water year.

If two acre-feet per acre had been used, the canal system as designed would not be affected, since if run to its maximum capacity for the whole irrigation season it would carry 2·5 acre-feet per irrigated acre. The difference to this estimate would be that in very dry years additional storage would be necessary to supply the total gross water required.

If the higher "duty" of 1·5 acre-feet over eighty per cent of the irrigable area were adopted, a less reservoir capacity would be required, or by using the same capacity more water for irrigation could be taken from the reservoir every year at the maximum period in June and July, and less water would be required from the river at this period, thus decreasing the required size of main canal and lessening the cost of the project.

RESERVOIR LOSSES AND REQUIRED CAPACITIES.

Since the Keho Lake reservoir occupies a natural sink or depression which at present contains water in a small lake a few acres in extent, it is thought that after a few years of use, when the underlying and adjacent strata become water-logged, the greatest loss will be from evaporation. A probable absorption loss would be a depth of four feet per year over an average reservoir area of 3,000 acres, or a total loss of 12,000 acre-feet. It is assumed that one-third of this loss, or 4,000 acre-feet, will occur during June, July, and August. By running the canals to their maximum capacity in September and May, and part of April if necessary, the reservoir can be filled by June 1 and hence the available storage, allowing 4,000 acre-feet loss, would be 37,000 acre-feet, the gross capacity of the reservoir being 41,000 acre-feet.

For the year 1910 the total required storage to supply 1·83 acre-feet to the entire irrigable area would be 40,000 acre-feet. (See hydrograph plate 1.) As the available storage is 37,000 acre-feet, this leaves a difference of 3,000 acre-feet not provided for, but it is reasonable to assume that even in the driest years there will be one or two days' rain in the three months of June, July, and August, when water for irrigation will not be required and the canal can be run to its capacity to supply this deficiency. Judging from records on the Oldman river at Cowley, which date back to May 1, 1907, the discharge during 1910 was the lowest for the past eight years, and considering the large factor of safety in not using an irrigation factor, it is thought that an available storage of 37,000 acre-feet is amply sufficient for this project.

For the years 1911, 1912, and 1913 the required storage amounts to only 5,000 acre-feet. The system is designed to use this amount of water every year from the reservoir at the maximum period in June and July, thus decreasing the size of main canal required from the intake to the reservoir.

For the year 1914 the required storage is 18,050 acre-feet. (See hydrograph plates II, III, IV and V.)

EXCAVATION.

Since the estimated cost of excavation on this project forms sixty per cent of the total cost, every care was taken to have the estimate of earth work as accurate as possible with the information at hand. All the larger canals which were approximately located in the field were plotted in plan to a scale of 400 feet to the inch and a location projected. A profile of this projected location was plotted to a scale of twenty feet to the inch vertically and 400 feet to the inch horizontally, and the excavation or borrow was estimated for each 200 feet of canal, allowing a ten per cent loss for settlement of banks and unavoidable waste. It is thought that when these canals are finally located and cross-sectioned in the field a better balance of cut and fill could be obtained which would tend to decrease the estimated earthwork. An average cost of 20 cents per cubic yard has been allowed for all excavation.

DESIGN OF STRUCTURES AND UNIT COSTS.

The different structures for this project were designed in sufficient detail to give a close approximate estimate of materials and were based on standard designs of irrigation systems now in operation in Alberta and the United States.

On canals over 40 c.s.f. capacity, all structures were designed to be built of concrete with the exception of flumes and bridges. Structures on canals under 40 c.s.f. capacity and flumes and bridges were designed of wooden construction. The unit costs used were as follows:—

$50 00 per M.B.M. for lumber in place.
15 00 per cubic yard for concrete in place.
2 00 per cubic yard of concrete for reinforcing.
1 50 per square yard for riprap.
60 per cubic yard for excavation and back-fill.

These units will vary on the different structures according to their size, distance from a railroad or gravel pit, labour conditions and numerous other factors, but they were taken as an average of actual costs on irrigation schemes which have been built under similar conditions.

The estimate includes an amount for fencing both sides of the right of way for the main canal at a unit cost of $300 per mile of canal, but it does not include any allowance for fencing laterals. The necessity of fencing will depend on the right of way agreement with the different farmers whose lands are affected. For convenience in watering stock, it is probable that many of the farmers will prefer to have the canal right of way left open. It is very difficult to make a close estimate of right of way costs, as they depend so largely upon the attitude of the owner towards the project. The present value of the land through which the canals are located averages probably $20 per acre, but to cover damages $40 per acre has been allowed for the right of way of all canals.

The following tables are a summary of the total costs of constructing the project:—

SUMMARY OF ESTIMATES.—Total Cost of Branch Canals, Secondaries and Distributaries.

Description.	Quantities.	Unit Costs.	Cost.	Total Cost.	Remarks.
			$	$	
Excavation	1,594,424 cubic yards	20c. per yard	318,887		452 miles of ditch.
Borrow	24,738 "	25c. "	6,185		
Right of Way	1,718·1 acres	$40 per acre	68,724		
Intakes and turnouts	1,127 structures		46,988		
Bridges and culverts	792 "		46,870		
Checks and drops	614 "		43,007		
Flumes and railway crossings			12,519		
				543,180	

Total cost of laterals per acre irrigated = $5.38.

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Summary of Estimates.—Total Cost of Project.

Description.	Dimensions.	Quantities.	Unit Costs.	Cost.	Total Cost.	Remarks.
			$ cts.	$	$	
Excavation	57 miles of canal	4,075,888 cu. yd	0 20 per yd	815,178		
Borrow		98,212 "	0 25 "	24,553		
Right of way	100 ft. max. width	695 acres	40 00 per acre	27,800		
Road bridges	16 ft. width	40	600 00 per b'dge	24,000		
Farm bridges		46	400 00 "	18,400		
Wooden flume, 8 by 16 ft	3,600 ft. long	1,827 M.B M.	50 00 per M	91,350		Crossing Oldman R.
" "	3,000 ft. "	1,055 "	50 00 "	52,750		Crossing Willow Cr.
" "	4,200 ft. "	1,664 "	50 00 "	83,200		Crossing Rocky Coulee.
Head works				22,121		
Fencing right of way	57 miles of double fence		300 00 per mile	17,100		
Land flooded by reservoir		3,690 acres	10 00 per acre	36,900		
Intakes and weirs in Pyami coulee				22,636		
Telephone line	60 miles		175 00 per mile	10,500		
Other structures				46,000		
					1,292,488	
Cost of laterals					543,180	
					1,835,668	
Engineering and contingencies at 15 p.c					275,351	
Total					2,111,019	

Total cost per irrigated acre = $20.90.

CONCLUSION.

The estimated cost of $20.90 per irrigated acre is based on a total irrigable area of 101,000 acres, and under efficient management the construction costs should not greatly exceed this amount. It should be clearly understood that this $20.90 per irrigated acre is the cost of construction only and does not include the cost of organization or interest on the capital invested while the project is being built. These additional costs will depend on the method adopted to raise the required funds and cannot be estimated in this report.

Sufficient information is not available at present to estimate the drainage canals required in connection with this scheme and it is probable that a small amount will have to be included to cover these costs.

Last year's preliminary estimate amounted to $18.84 per irrigated acre, but it seemed to be the impression of a number of the settlers that the total cost to them of putting the water on their lands would be $18 per irrigated acre.

Before this scheme can be constructed plane table surveys will have to be made of the irrigable areas so that the land can be accurately classified, and each settler will know definitely the number of acres of his land which are irrigable and the proportion of the cost he will be called upon to bear. It has been decided to carry out these surveys during the coming field season.

The following plans and profiles of the Oldman River project are on file in this office:—

Plans—

Roll I. Line "A," intake to end.
" II. Line "B," intake to reservoir.
" III. Reservoir to Keho lake.
" IV. Line "B," reservoir to end and branch canals.

Profiles—

No. 1–4. Line A, Sta. 0 00 to end.
" 5. " "B," intake to Sta. 524 00.
" 6. " "B," Sta. 524 00 to 1510 00.
" 7. " "B," Sta. 1510 00 to 1748 00.
" 8. " B, Sta. 1890 00 to 2830 00.
" 9. " B, Turin branch and secondaries.

REPORT ON INSPECTION OF LARGE IRRIGATION PROJECTS.

By Sam. G. Porter, Assistant Chief Engineer.

Calgary, March 31, 1915.

I have the honour to submit the following report on the inspection of the large irrigation systems during the past season.

PERIOD AND SCOPE OF FIELD WORK.

The period of field inspections extended from April 20 to November 4. During that period about one-half my time was spent on outside inspection and one-half in the office examining plans and writing reports. The territory covered embraced the eastern section of the Canadian Pacific Railway Company's irrigation block, the Southern Alberta Land Company's system, and the Alberta Railway and Irrigation Company's system. None of the western section of the Canadian Pacific Railway was included, except the dam across the Bow river at Calgary.

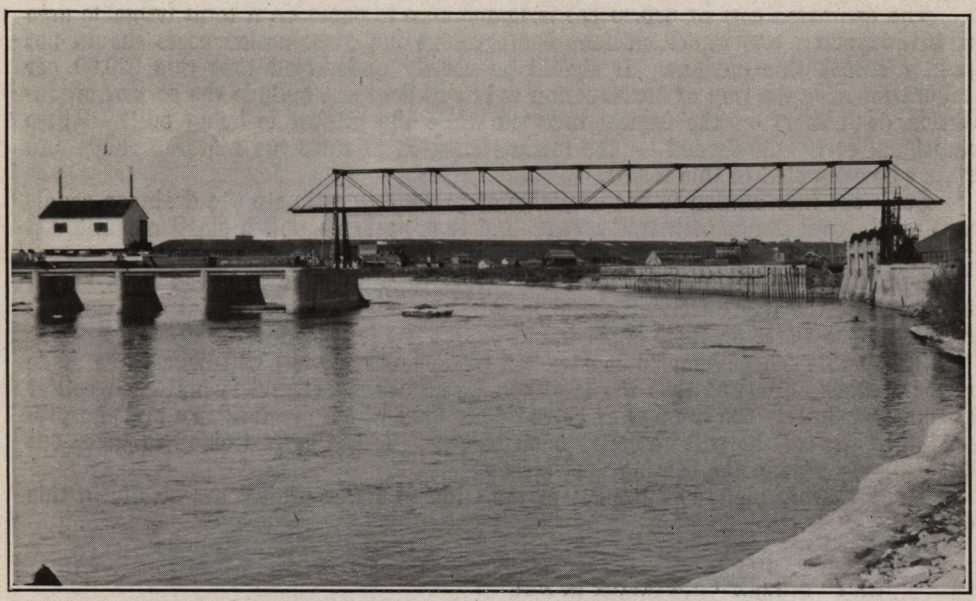

Photo. by S. G. Porter, March 22, 1915.

Diversion Dam Western Section C.P.R., on Bow River at Calgary. Looking upstream. Steel Sector Section completely lowered into pit. Foot bridge above sector section. Canal Headgates on rights. Part of stop log section on left showing operating house for electric crane which moves on track on top of dam.

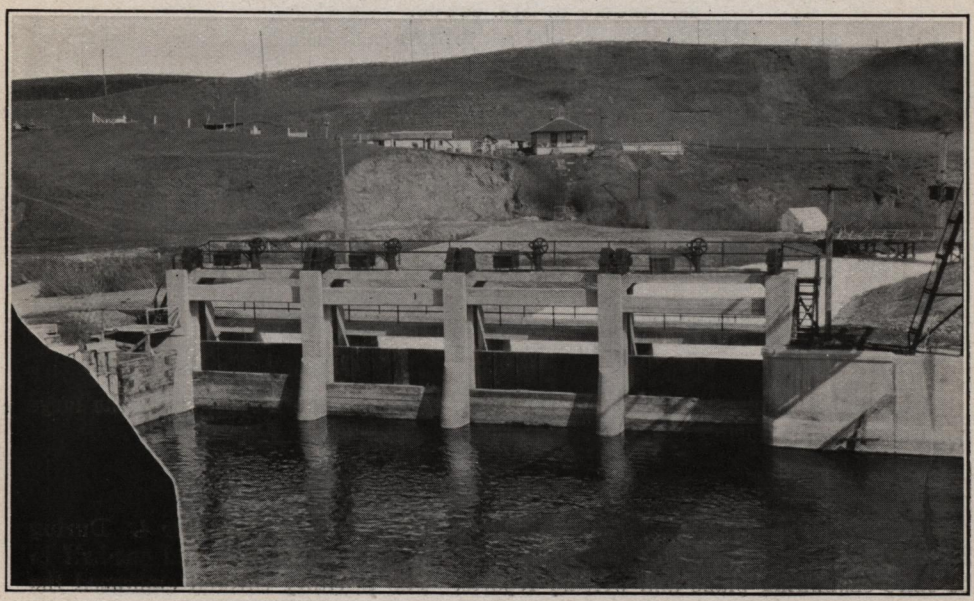

Photo. by S. G. Porter, March 22, 1915.

Headgates, Western Section C.P.R. Canal. From foot bridge above Sector Section of dam.

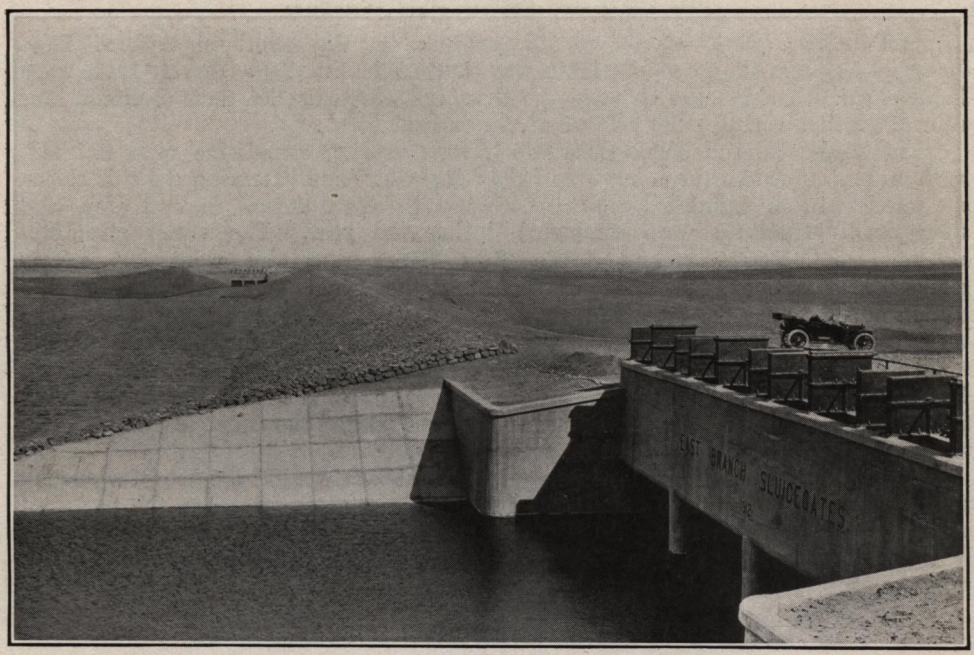

Photo. by F. G. Cross, Dept. Nat. Res., C.P.R.

Crawling Valley Dam. Eastern Section C.P.R.

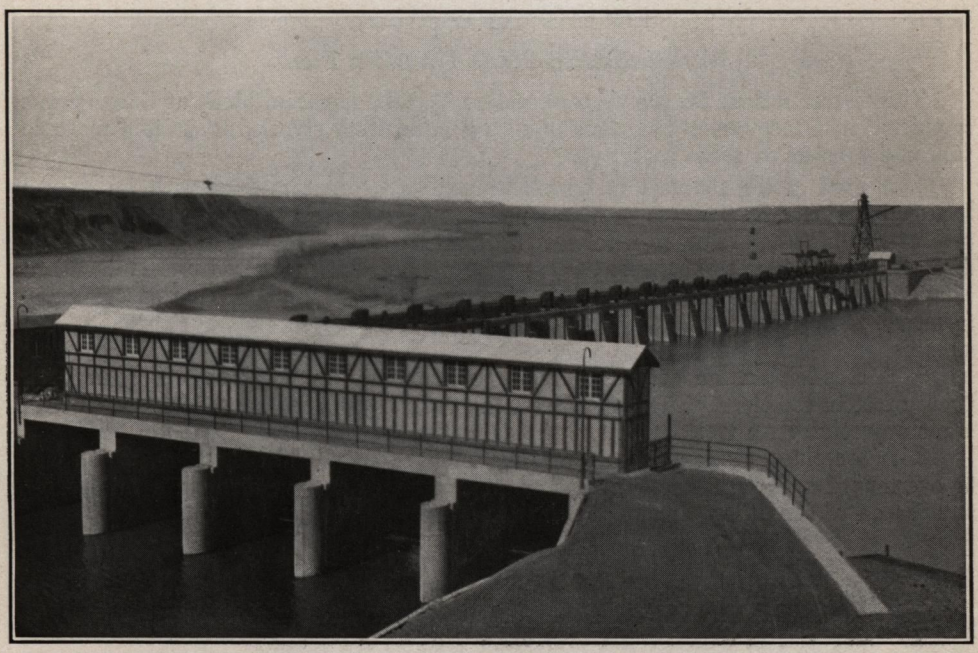

Photo. by S. G. Porter, April 21, 1914.

The Bassano Dam. Eastern Section C.P.R. Irrigation Block. Canal intake in foreground.

THE SOUTHERN ALBERTA LAND COMPANY.

Construction work which was in progress on the Southern Alberta Land Company's system the previous season was continued until September 1, 1914, when financial conditions brought about by the European war compelled them to discontinue all construction work for the balance of the season.

The head-gates and sluice-gates which were nearing completion were finished; work was continued on the enlarging of the "Big Cut" and flattening the side slopes, but was left in an unfinished condition when work closed down. Several drops and other small structures were completed during the year. The outlet structures of the Lake McGregor and Little Bow River reservoirs were left nearly completed. Part of the work of puddling the canal along the Little Bow section and building the cut-off into the Little Bow River reservoir was done. The outlet canal from the Little Bow River reservoir to the point where it joins the old canal line was practically completed. Some of the lateral ditches in the western district were built, but the structures were not put in. The steel bridge for carrying the wood stave pipe over the Bow river was completed and the concrete cradles built, but the pipe itself was not assembled.

Had not financial difficulties interrupted the work it would have been far enough advanced during the year to permit the delivery of irrigation water to the first unit of the irrigable area in 1915. As it was, a run of water was started in the summer of 1914 from the river to lake McGregor, but only continued long enough to fairly prime the supply canal. No appreciable amount was stored.

THE ALBERTA RAILWAY AND IRRIGATION COMPANY'S CANAL.

Many of the structures on this system have been in use for about fifteen years, and being of timber will have to be renewed. During the past season the big flume over Willow creek was rebuilt, and two other flumes on the main canal were torn out and replaced by earth embankments.

BOW RIVER DAM AT CALGARY.

Western Section C.P.R. Irrigation Block.

The diversion dam for the western section C.P.R. irrigation block at Calgary was completed in December, 1914. This is a very interesting structure. It is a movable dam and consists of three parts:—

1. A steel sector 152 feet in length hinged on a concrete floor with its curved face up stream. It operates semi-automatically by the control of the hydrostatic pressure within the sector by a telescoping annular weir in a well at the end of the dam, which may be set to balance the external pressure at any desired position. When completely lowered the sector sinks into a concrete pit, and the steel top of the sector forms a flat floor level with the river bed and offers no obstruction to the flow of the stream.

2. A stop-log section 555 feet long, consisting of twenty-three openings each twenty feet in the clear. The stop-logs set in concrete piers are handled by an electric crane operating on a track on top of the dam.

3. A breeching section, or earthen dike, at the south end of the dam, which will be overtopped and washed out in case of an emergency arising through a failure for any reason of the other parts of the dam to handle a flood.

Eastern Section C.P.R. Irrigation Block.

Construction.—All the principal features in the construction of the eastern section system were completed in 1914. Only the small structures on some of the laterals remain. The dam at Bassano was completed early in the summer.

Operation.—Water was first turned into the canal April 21, 1914. Twenty-four water users in the Bassano colony, under the North Branch canal, were supplied with water for irrigation in the season of 1914. In addition to this, several of the farms

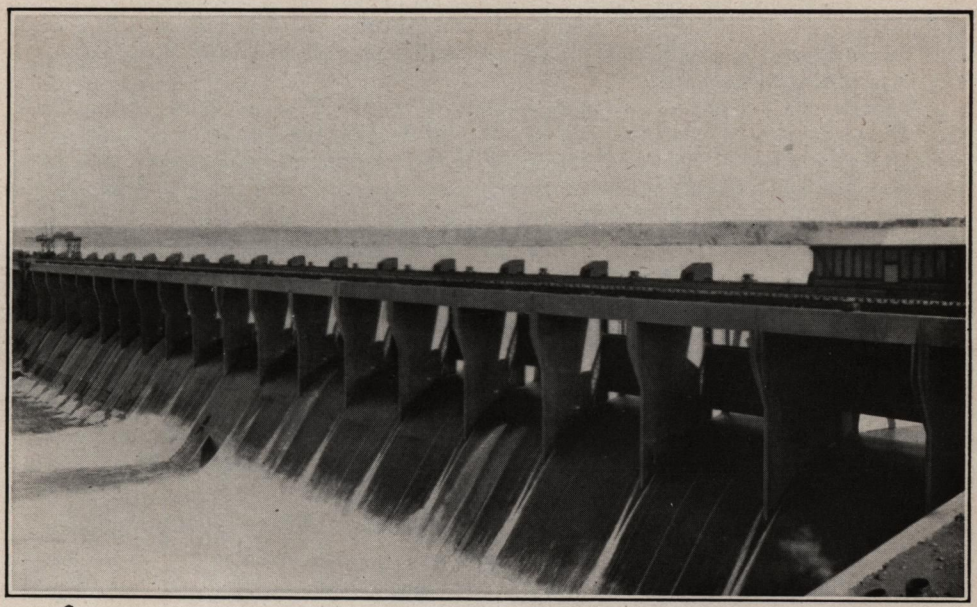

Photo. by S. G. Porter, April 21, 1914.
The Bassano Dam. Eastern Section C.P.R. Irrigation Block.

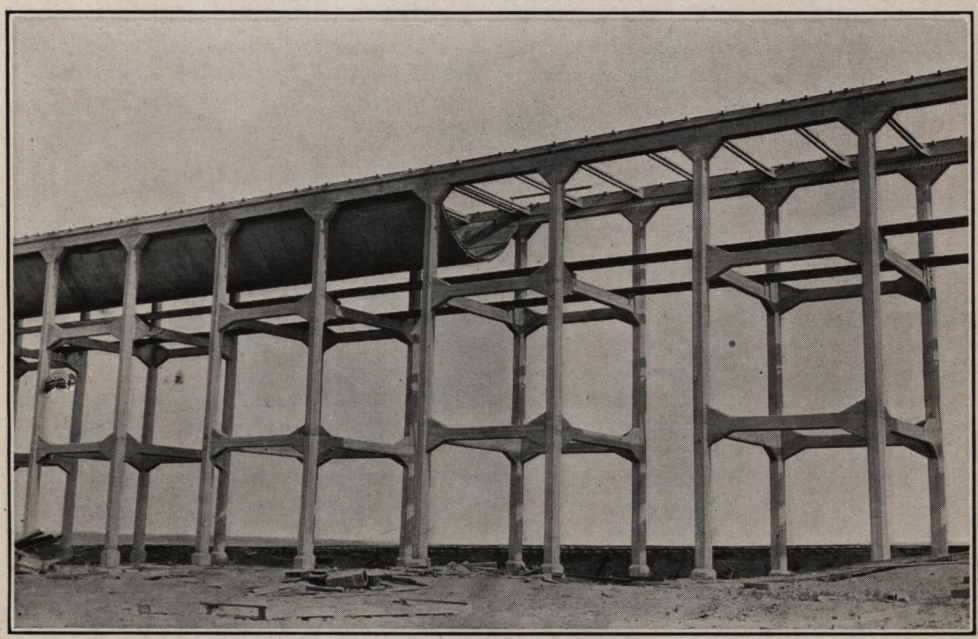

Photo. by H. B. Muckleston, Asst. Chief Engr. Dept. Nat. Res. C.P.R.
Brooks Aqueduct—Bantry Canal Eastern Section C.P.R.

in the Rosemary colony under the Spring Hill canal were irrigated in the fall by the company; a small part of the Sutherland colony under the North Bantry canal was fall irrigated, and approximately 70,000 acre-feet were run into lake Newell through the East Branch main canal.

The Brooks aqueduct is next in magnitude to the Bassano dam. It is built entirely of reinforced concrete, is two miles in length, twenty-one feet four inches wide at top inside, 10 feet two inches deep, with a maximum height above ground of fifty-five feet, and presents a very imposing appearance. It was completed late in the summer of 1914, and the first water was run through it in September.

Land Classification.—The greater part of the season was devoted to the inspection of the irrigable land in the eastern section C.P.R. irrigation block. A field party under J. S. Tempest was engaged in this work from May 5 to November 21. The party consisted of Mr. Tempest, field engineer; P. A. Fetterly, assistant engineer; a rodman, a teamster, and a cook. Continuing the work started in 1913, the six townships which were partially completed that year were completed, and the balance of the area lying west of the range line which passes through lake Newell and two and a half townships east of that line were inspected, comprising a total area as shown below:—

—	Irrigable.	Non-Irrigable.	Right of Way.	Total Area Inspected.
	Acres.	Acres.	Acres.	Acres.
1913	43,455.92	27,156.687	1,849.503	72,462.11
1914	186,244.83	137,546.261	9,185.019	332,976.11
Total to date	229,700.75	164,702.948	11,034.522	405,438.22

This comprises the whole irrigable area under the North Branch canal; the whole irrigable area under the Bow Slope canal;; the whole irrigable area under the Antelope Creek canal; the whole irrigable area under the East Branch canal; the western and central parts of the irrigable area under the Spring Hill canal; and a small part of the area under the Bantry canal.

OFFICE WORK.

During the year I have examined for approval the following plans:—

A. R. and I. Co.—27 plans, 30 sheets.

C.P.R. Eastern Section, structures—33 plans, 77 sheets.

C.P.R. Eastern Section, topography of irrigable lands—30 townships, 93 sheets.

In addition to these which have been signed for approval, a great number of plans, profiles and maps have been studied and used in connection with the land classification work and various reports, but which have not yet for one reason or another been passed for official approval.

Mr. Tempest and Mr. Fetterly have spent the winter season compiling the classification lists for areas inspected on the eastern section C.P.R. irrigation block during the field season. This work included the checking of the C.P.R. irrigable and non-irrigable areas on the maps, subtracting from their irrigable areas the lands we had classified as non-irrigable and adding areas found to be irrigable. These changes were tabulated for use in making up final classification schedules for official approval, and the final classification was also indicated in colours on contour maps to be filed in the Calgary and Ottawa offices for future reference and information. In making up the coloured maps we have had the assistance of J. H. Jones, assistant engineer, in the office since September, 1914.

The net reductions in irrigable area which we have made in the C.P.R. classification have amounted to approximately four per cent.

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Map suppl.

DEPARTMENT OF THE INTERIOR

DOMINION OF CANADA

PLANS TO ACCOMPANY REPORT ON IRRIGATION SURVEYS AND INSPECTIONS FOR THE YEAR 1915.

Sketch Map Showing First System of Canals.
Sketch Map Showing Second System of Canals.
Map of Area Developed by Milk and St. Mary River Surveys.
Key Plan to Surveys in Sundial District.
Plan of Surveys, Oldman River Project.

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Department of the Interior

IRRIGATION BRANCH

CALGARY – ALBERTA

SKETCH MAP

SHEWING

2ND SYSTEM OF CANALS

TO IRRIGATE LANDS

TRIBUTARY TO THE MILK AND ST. MARY RIVERS

TOTAL IRRIGABLE AREA 354834 ACRES

SCALE 6 MILES TO 1 INCH

LEGEND

CONSTRUCTED CANALS ——

PROJECTED CANALS ——

To accompany report of the Commissioner of Irrigation Year. 1914.

CHIEF FIELD INSPECTOR B. Russell

CHIEF ENGINEER F. M. Stews

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TRACT 2.
I.A. 31700 Acs.
TRACT 3.
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BLOOD INDIAN RESERVE
MILK RIVER
MILK RIVER RIDGE
BELLY RIVER
WATERTON RIVER
ST. MARY RIVER
LITTLE BOW RIVER
OLDMAN RIVER
CROW INDIAN LAKE
Chain Lake Reservoir
Bootleg Reservoir
Milk River Reservoir
Happy Butte Reservoir
Lake Sherburne Reservoir
Lake Frances Reservoir
Proposed Belly River Reservoir
Proposed Belly River Reservoir Canal
Proposed Waterton Reservoir
Proposed Waterton Reservoir Canal
Proposed Lake Frances Reservoir
Proposed Lake Frances Reservoir Canal
Proposed Lake Sherburne Reservoir
Proposed Lake Sherburne Reservoir Canal
Proposed Milk River Reservoir
Proposed Milk River Reservoir Canal
Proposed Happy Butte Reservoir
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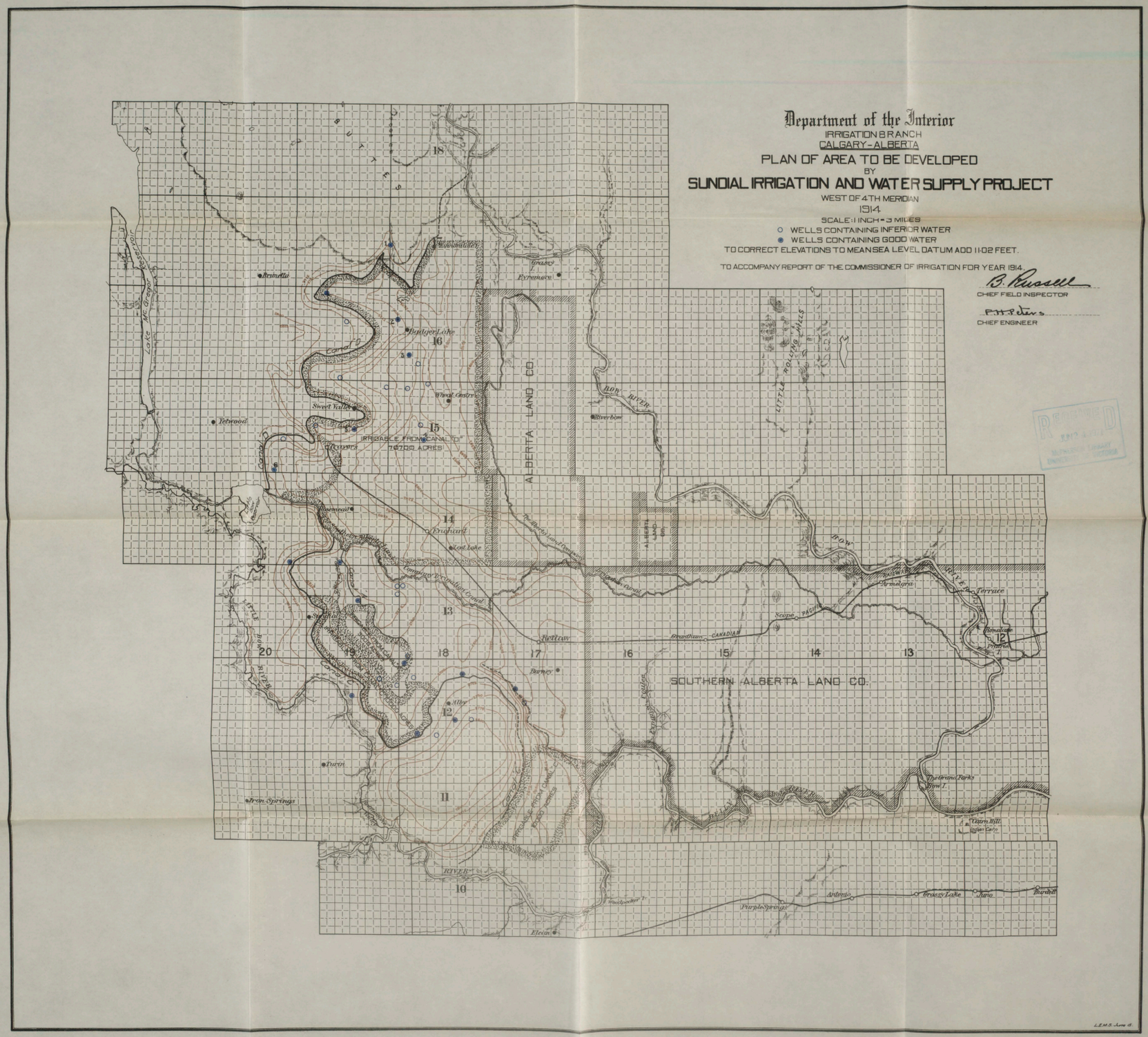
Department of the Interior
IRRIGATION BRANCH
CALGARY-ALBERTA
PLAN OF AREA TO BE DEVELOPED
BY
SUNDIAL IRRIGATION AND WATER SUPPLY PROJECT
WEST OF 4TH MERIDIAN
1914
SCALE: 1 INCH = 3 MILES
WELLS CONTAINING INFERIOR WATER
WELLS CONTAINING GOOD WATER
TO CORRECT ELEVATIONS TO MEAN SEA LEVEL DATUM ADD 11.02 FEET.
TO ACCOMPANY REPORT OF THE COMMISSIONER OF IRRIGATION FOR YEAR 1914.
B. Russell
CHIEF FIELD INSPECTOR
P.H. Peters
CHIEF ENGINEER
ALBERTA LAND CO.
SOUTHERN ALBERTA LAND CO.
IRRIGABLE FROM CANAL "D"
70700 ACRES
Brinnella
Badger Lake
Wheat Centre
Sweet Valley
Tetwood
Rosemead
Enchant
Lost Lake
Retlaw
Barney
Alby
Turin
Iron Springs
Elean
Purple Springs
Antonio
Grassy Lake
Juno
Burdett
Armelgra
Terrace
Ronalane
Prairie
Grandham
Scope
Eyremore
Riverbow
Little Rolling Hills
Bow River
Little Bow River
Lake McGregor Reservoir
Canal "D"
Canadian Pacific Railway
The Grand Forks
Bow I.
Cairn Hill
Indian Cairn
Woodpecker
18
16
15
14
13
12
11
10
20
19
17

Department of the Interior

IRRIGATION BRANCH

GENERAL PLAN

SHEWING

PRELIMINARY SURVEYS

OF

OLDMAN RIVER IRRIGATION PROJECT

1914

Scale - 2 Miles to 1 Inch.

TOTAL IRRIGABLE AREA ESTIMATED 101000 ACRES

LEGEND:-

Projected Canals shewn thus. ——

Irrigable Areas . . .

Engineer in Charge:- V. Meuts

Chief Field Inspector:- B. Russell

Chief Engineer :- P. M. Peters

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IRRIGATION BRANCH

CALGARY - ALBERTA

MAP OF AREA DEVELOPED BY MILK AND ST. MARY RIVERS SURVEYS 1914.

CHIEF FIELD INSPECTOR B. Russell

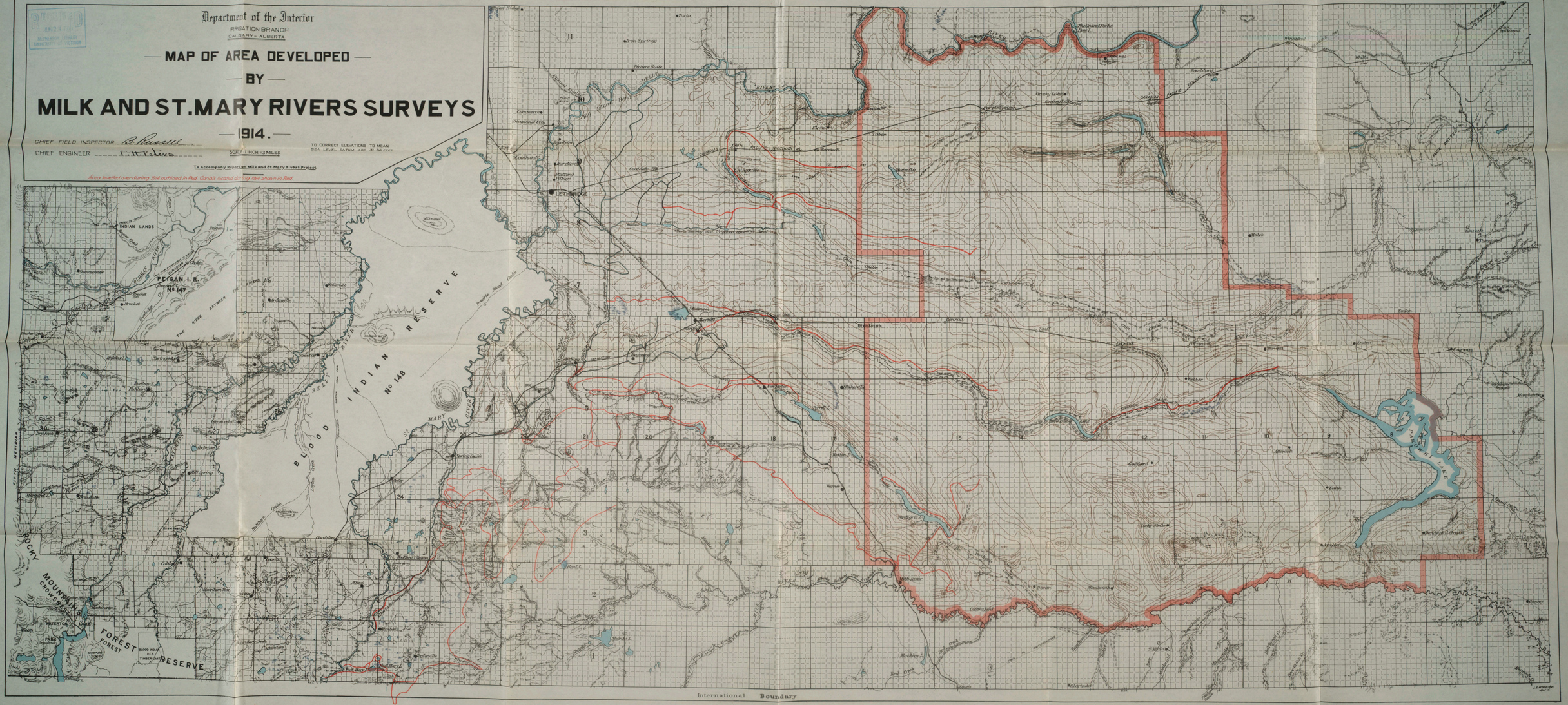
CHIEF ENGINEER F. M. Peters

SCALE 1 INCH = 3 MILES

TO CORRECT ELEVATIONS TO MEAN SEA LEVEL DATUM ADD 31.86 FEET

To Accompany Report on Milk and St. Mary Rivers Project

Area levelled over during 1914 outlined in Red. Canals located during 1914 shown in Red.



International Boundary